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AUTOMOBILE STORAGE BATTERIES.

Elsewhere in this issue we print an article giving an account of the principal storage batteries designed more especially for automobile work. With one or two exceptions the list is inclusive of all the batteries for automobile service now commercially available in this country. It is quite significant that applications for information concerning automobile storage batteries for which sensational newspaper claims have been made, were in every case fruitless. The data of batteries described have been obtained from the several manufacturers, and the claims in descriptions as to points of superiority are also those of the makers. Such an *ex parte* presentation has at least the advantage that the reader has placed before him the best that can be said of each battery considered, and by comparison of the claims he can, in connection with the descriptions given, form some sort of a personal opinion as to relative merit. It is only fair to say that too much stress should not be laid upon the comparisons given upon the basis of a three-hour discharge. If each battery were designed for precisely the same service, and there were a definite standard of durability, such a comparison would be proper. In the present stage of the automobile batteries, however, this is not the case, and even when the automobile has become thoroughly established commercially in the great field open for it, the requirements of different services will result in battery differentiations that will continue to preclude such a comparison. In considering the comparisons given, the reader should, therefore, have due regard to the constructional and other details of the different batteries considered.

At present there is in this country no disinterested source to which one, in case of need, may have recourse for data upon which to base an opinion as to the capability of different types of storage batteries for a given service. We firmly believe that in no manner could electric automobilism be so well served and as rapidly advanced in this country as by service trials of storage batteries patterned after those which are annually conducted in France by the Automobile Club of that country. If a corresponding American body were to institute similar trials here, it would perform an infinitely greater service than by effort wasted in encouraging racing contests, which are of practically no value in the advancement of the art as a whole. While the French trials may not have had any remarkably beneficial effect, we believe that such trials here, but conducted along somewhat different lines would, by powerfully directing the attention of our manufacturers and inventors to the really essential points of the storage battery as applied to automobile work, accomplish wonders in perfecting batteries for such work. There does not appear to be any uniformity in such service trials as are at present made, and scarcely any deductions can be drawn from the results obtained, which remark also to some extent applies to the French trials. What appears to be called for is a system whereby trials may be made with storage batteries on the basis of several tractive efforts and speeds to be fixed by the conditions of the different services, the capacities of batteries to be determined by the distance run on a single charge, and a sufficient number of runs being made to give some indication as to the rate of depreciation. A battery making a favorable showing under such conditions would then be known to be worthy of the more extended tests to determine its true practical value on the basis of the cost per tractive unit per mile in terms of investment, depreciation and up-keep.

AN IMPROVED APPARATUS FOR ARC-LIGHT PHOTOMETRY.

The paper on this subject by Professor Matthews, read last week before the A. I. E. E., is an interesting contribution to the literature of photometry. The special problem under consideration in the paper is the measurement of the mean spherical candle-power from a single observation of an enclosed arc lamp, or of an arc lamp in a glass globe. This is such a large luminous source that special apparatus has to be employed for automatically determining the spherical candle-power. The plan is to place a mirror at each 15 degs. of a vertical circle including the arc lamp, representing 24 mirrors in all, and interpose a smoked screen in the path of the reflected beam from each mirror in such a manner that the ratio of the light thrown by the mirror towards the photometer screen, to the light thrown by a mirror at zero elevation, is approximately equal to the cosine of the angular elevation of the mirror. Thus the mirrors 60 degs. above or below the horizontal plane should reflect to the photometer just half the light that is thrown by the mirrors on the horizontal plane. Theoretically, of course, the number of mirrors should be very large, but, practically, one for each 15 degs. is allowed, and these, if correctly calibrated, would no doubt supply a fair approximation to the actual mean spherical candle-power.

The principal objection to the apparatus is the large amount of labor required to adjust the absorption of the 22 mirrors actually used, and the liability of the absorption to increase unduly or irregularly with age. Moreover, the total light thrown on the photometer screen is 15.2 times as strong as that which a single mirror reflects at the horizontal plane, or 15 times as much light as the most favorably situated mirror, into the path of which no absorption is introduced. For this reason, the illumination at the photometer screen is very great, unless the photometer is to be of unusually great length. Professor Matthews inserts a revolving sectored disk into the composite beam so as suitably to reduce the total intensity of illumination at the photometer screen. Of course, once the instrument has been set up and properly calibrated, there can be no doubt of the advantage of obtaining the mean spherical candle-power from a single measurement, instead of from a considerable number of successive measurements at different elevations, followed by calculation.

Although the spherical candle-power determination of any source of light is the only reliable basis of comparing dissimilar and dissymmetrical light sources, yet it seems inadvisable to rate or estimate lamps in commercial practice by their mean spherical candle-power. For example, an incandescent lamp of 16 mean horizontal British candle-power, is a lamp which in a mean horizontal direction emits within a very small solid angle 16 times as much light as a British standard candle through the same small solid angle. Such a lamp might have a mean spherical candle-power of 13 candles, which is the same as saying that the lamps emit 13 times as much light in all directions, as a British candle would emit if it were a glowing point capable of emitting light equally in all directions. If spherical candle-power determinations became frequently necessary in order properly to compare lamps of different filamentary shapes, we might thus fall into the liability of confusing the spherical with the horizontal candle-power, and when we spoke of a 16-cp lamp it might become a matter of doubt as to whether we meant a lamp of 16 mean horizontal candle-power, or a lamp of 16 mean spherical candle-power, which latter would correspond to some 19.5 mean horizontal candle-power.

In order to avoid this confusion, it would be far preferable to refer all mean spherical determinations to the quantity of light emitted, and state the result in lumens instead of in candle-power. Since a British candle, assumed as a point-source, emits 4π or 12.567 British lumens, or a Hefner-Alteneck lamp emits similarly 12.567 Hefner lumens, all we have to do is to multiply the mean spherical candle-candle-power of a lamp, as measured in Hefner's or British candles by the factor 12.567, and the result is the total quantity of light emitted by the lamp in all directions, expressed in the corresponding lumens. Thus a 12-cp lamp would be a lamp of 12 mean horizontal British candle-power, but probably of about 125 British lumens. The advantage of this plan is that not only would all confusion in rating be avoided, but that so long as we use the word "candle-power" in defining a lamp, we should understand that we refer to its luminous intensity in a horizontal direction, whereas when meeting the term lumen we should know that the light emitted is referred to, and this would naturally mean the total light emitted, or the spherical emission of light.

CLUTCH VS. RHEOSTAT IN ELECTRIC TRACTION.

The discussion which has been so actively going on for the past few months on the relative merits of alternating and direct-current motors for long electric railway lines does not appear to take into account some of the possible solutions of the problem of doing away with rotary converter sub-stations and supplying alternating-current direct to the car motors. The discussion so far has been based on the assumption that the present system of gearing the motors to the car axles is to be preserved. It is, of course, natural to assume that the present method of gearing the motors directly to the axles—a method which is the survival of the fittest after numerous experiments made when street railway motors were being first developed—is the one to be followed in all future work. It does not, however, necessarily follow that the arrangement which early experiments determined to be the best for street railway service with direct-current motors will fit itself to long-distance alternating-current work as well as some other. This is a point, however, upon which at the present time it would be unwise to express a decided opinion one way or the other. There are a number of difficulties in connection with the use of alternating-current motors for railway purposes that would be so nicely wiped out by the adoption of a clutch connection between motor and car axle in place of the present gears or direct mounting, that it would by no means be surprising if some attempts were made in the near future to work out a successful plan whereby the motors could be run continuously and the car or electric locomotive started by means of a magnetic or friction clutch.

In view of the unsatisfactory outcome of early experiments with clutch mechanism for street railway motors as compared with rheostatic control, there are plenty of engineers who will not be enthusiastic on the clutch proposition. The electrical advantages made possible by it, however, are tempting enough to induce the expenditure of considerable money and thought on such a plan in spite of past decisions in favor of the rheostat as against the clutch. The manifest advantage offered by a continuously running motor on the car is the possibility of making that motor a single-phase motor and transmitting current at high voltages over a single trolley line direct to the motor. This is the same advantage offered by the polyphase railway motor, but lacking the drawback of the double trolley needed for the polyphase motor. The equipment of a motor car or locomotive with a single-phase motor would, of course, require complications not found on a direct-current locomotive, but it is fair to assume that in many cases where alternating-current motors are most desirable for transmission reasons, the extreme simplicity of a street car electrical equipment would not be essential. A little more complication on the locomotives could be indulged in for the sake of eliminating sub-stations with rotary converters. The main point at issue would be the success or failure of the plan of starting the train through the medium of magnetic or friction clutches.

This leads us to a consideration of the fundamental differences between starting a car by means of a rheostat and motors geared solidly to the axles on the one hand, and starting it by clutches with motors constantly running at fixed speed on the other hand. The essential differences are by no means as radical as might at first sight be supposed. In both cases the torque of the motor necesary to start the train is the same if the equipment of motors and ratio of the reduction gears are identical. Hence, the current flowing during acceleration would be the same in the two cases. In one case the surplus electrical energy not taken in train acceleration is dissipated as heat in the rheostat. In the other case it is dissipated as heat in the clutch. The main problem would, therefore, seem to be in the design of a clutch which should be able to dispose of a large enough quantity of energy during the starting of the train without destroying itself too rapidly. This would not seem to present any insurmountable difficulties, especially when the efficiency ease of control and indestructibility of some of the magnetic clutches designed within the past few years is considered. The results obtained, for example, with the magnetic clutch designed for power house uses by Mr. Bion J. Arnold are almost astounding in the small quantity of energy consumed for clutches of great power. The selection of the clutch rather than the rheostat for roads of the kind here discussed may ultimately prove to be impracticable for reasons not now apparent, but it is extremely probable that such methods will at least be given a trial even though they mean such a radical change from methods now in common use. Incidentally, it may be noted that the grips on cable roads have for twenty years past offered examples of successful power transmission through clutch mechanism which should be encouraging to the experimenter along this line.

A Hundred and Twenty-Five Miles an Hour.

In this issue we print a continuation of the account from authoritative sources of the initiation of the remarkable high-speed experiments for the Berlin-Zossen experimental electric road. This is by far the most determined attack on the high-speed problem that has yet been made on either side of the Atlantic, and if skill and experience count for anything, success may fairly be predicted. The only factor in the work which seems somewhat uncertain is the character of the track and roadbed. Although these are constructed with the thoroughness to be expected in a Prussian military road, grades up to 3 per cent and radii of curvature even as short as 1000 meters can hardly be considered as unduly favorable to the attaining of transcendental speeds. As a preliminary to the design of motors and car equipment, Siemens & Halske made an independent series of experiments with whirling bodies to obtain the air resistance to be allowed for at the speeds under consideration. The method employed is substantially that used by Crosby a decade since, but there is a somewhat interesting divergence from Crosby's results. These, somewhat to everyone's surprise, showed that the resistance due to air pressure was quite nearly a linear function of the speed. The German tests seem to show a marked increase of resistance as the speed rises. In the tests with flat surfaces the apparent resistance per square foot from the Berlin results was at 125 miles per hour nearly double the resistance found by Crosby, while the results from a short body bluntly parabolic was as great as Crosby obtained from a body with plane surfaces. The discrepancy is so great as to require investigation. In the German work the bodies were much larger in proportion to the radius of the whirling arms, and the latter were absolutely shorter than in the earlier American tests. If, as has been supposed, the air currents and eddies established in the whirling test tend to lessen the apparent resistance, then the recent results should be smaller instead of larger. It looks very much as if in operating at relatively small radii with a tangentially directed body the eddies, perhaps in the rear, actually increase the resistance very considerably. At all events, results obtained from whirling tables seem open to some doubt, and we shall await the result of the track tests with great interest, although all the American results, however obtained, seem to show that the resistances actually found will be materially smaller than those allowed for in the Zossen work. This, happily, is an error in the right direction.

As regards the general methods used, it will be noted that they run exactly counter to the opinions lately emitted by some American engineers. The two great German firms charged with the electrical equipment of the motor cars have already built and tested polyphase motors to go directly upon the car axles and to deliver a nominal output of 250 horse-power and a maximum output of 750 horse-power each. They have put aside both rotary converters and low frequencies, and are going to work at 50 cycles, taking the energy from a 10,000-volt trolley line. They propose to employ rheostatic regulation in the secondary circuits and to use side running trolleys. We are inclined to think that in the main the German engineers will succeed, although probably not without many minor difficulties cropping out when and where least expected. Of course, there is much to be demonstrated beyond the conditions of operation at 125 miles per hour or more, much that will be perfectly smooth sailing in the way of the collection of data. As to the mere attaining of the speed in question there is substantially no doubt even now, provided the track and roadbed will permit. The actual conditions of operation in the running contacts, the regulating appliances and the brakes are far more serious subjects for consideration than the mere power and efficiency of the motors, on which depend the reaching and maintenance of very high speeds. And most of all, is it important that the conditions of station operation when handling such traffic as the purpose of the tests contemplates be accurately ascertained.

Many of the minor features of the two experimental cars described are of great interest. For example, the use of wind sails on the roof to furnish ventilating blasts for the high-tension transformers, thereby greatly reducing their weight, is an ingenious touch of no little practical value. Likewise, the adaptation of a liquid starting resistance with its cheapness and great delicacy of control through forced circulation of the electrolyte, is a daring solution of what otherwise might be a very troublesome problem. The motors seem to have been very shrewdly designed, although many details of their structure and performance are as yet wanting. Yet a total weight of less than 29 lbs. per horse-power of normal output, with a capacity for working up to an output of a horse-power for barely 10 lbs. of weight, shows that our German confreres know a thing or two about the efficient utilization of material. Although differing in many details, the cars of Siemens & Halske and of the A. E. G. follow the same broad lines to conclusions anything but wide apart so far as the preliminaries show. It is safe to say that both the equipments will perform well, although it will be very interesting to note the difference, for instance, between liquid and metallic rheostats, the *pros* and *cons* of shifting from star to mesh connections, and the relative efficiency of the braking devices. All these matters are material in settling upon the lines to be followed in the practical equipment of a high-speed road, but they are subordinate to the broad facts on which the commercial side of the matter depends. We shall await with the most profound interest the results of the track experiments, with confidence in the ultimate success of the attempt for high speed. We hope, too, that the reports of the progress of the work will be full and complete, for the engineering details will be most interesting, and will go far towards making or marring the future of high-speed traction.

Programme for the American Street Railway Convention.

The twentieth annual meeting of the American Street Railway Association will be held at Madison Square Garden, New York City, Oct. 9, 10 and 11, accompanied by a display of fine exhibits, which will more than fill the great arena. The programme is as follows:

On Wednesday, Oct. 9, 10.30 a. m., the meeting will be called to order, and Walton H. Holmes, president, will deliver his address.

Papers will be presented on Wednesday and Friday on the following subjects: "Street Railways; a review of the past and a forecast of the future"; "The adoption of electric signals on suburban and interurban railways, single or double track, and their economy of operation"; "The value of storage batteries as auxiliaries to power plants"; "The public, the operator and the company"; "The best manner and mode of conducting the return circuit to the power house"; "The American Street Railway Association; The purposes of its organization and the benefits accruing to investors in and operators of street railway properties by membership therein"; "The economies resulting from the use of four motors instead of two on double motor equipments"; "The best form of car for city service; A consideration of the various types of car as to size of car and arrangement of seats, including best types of brakes and wheels"; "Practical results obtained from three-phase transmission power on railway lines"; "Relations of Interurban and city railways"; "The modern power house, including the use of cooling towers."

Thursday, Oct. 10, will be Supply Men's Day. The entire day will be given to the examination of the exhibits.

Friday, Oct. 11, 1901, the convention will meet at 10 a. m. and the election of officers for the ensuing year will take place.

At 7.30 p. m. the annual dinner will take place at Sherry's, Forty-fourth Street and Fifth Avenue, New York City. The installation of the officers-elect will take place at the dinner.

On Saturday the Bethlehem Steel Company has extended to members the hospitalities of its works at South Bethlehem, Pa., running a special train. During the week, the Street Railway Accountants will be in session, also in one of the rooms at the Garden, and several interesting papers will be discussed. Headquarters of the association for the week will be established at the Murray Hill Hotel and at the Garden. The Bell telephone system has been put at the free disposal of members, the New York Telephone Company placing also a telephone in the space of each New York exhibitor. The New York Edison Company will furnish current free to exhibitors during the week. Free street railway fare, honoring badges, will be given on all lines in Greater New York and suburban New Jersey.

Electrical Engineers of the Day—XIV.

W. L. R. Emmet.

William Le Roy Emmet was born in New Rochelle, N. Y., July 10, 1859. Mr. Emmet is of Irish descent, being a great-grandson of the Irish patriot, Thomas Addis Emmet, brother of the famous Robert Emmet, who was executed in 1804. After a preparatory education in various schools in this State and in Canada, Mr. Emmet entered the Naval Academy, from which he was graduated in 1881. After serving two years in the navy he was honorably discharged by enactment of Congress in 1883, with the majority of his class. During the late Spanish-American War Mr. Emmet served as a naval volunteer officer.

Mr. Emmet's advent in the electrical field was in the year 1887, when he became connected in a subordinate capacity with the old United States Illuminating Company, and was thus identified with some of the earliest electric light work in New York. After a year with this company, he joined the Sprague Company, with which he remained until 1890, being actively connected with all the more important electric railways installed by that pioneer organization. At different times and for short periods, Mr. Emmet, acting on behalf of the Sprague Company, was superintendent of the original railway installations in Cleveland, St. Louis, Pittsburg and Harrisburg, Pa., and many other places. On the absorption of the Sprague Company by the Edison General Electric Company, Mr. Emmet joined the staff of the Westinghouse Company, where he remained for a few months, continuing the work of superintendence of installations of railway plants. Mr. Emmet then engaged for a period of about a year, in the manufacture of various railway appliances invented and developed by himself. After a short engagement as the electrical engineer of the Buffalo Railway Company, he accepted an offer of the Edison General Electric Company to become the engineer of its Chicago office, which position he occupied until the consolidation of the Thomson-Houston and Edison General Electric companies, when he was assigned to the general office in New York City. His work here was of a general consulting nature. Mr. Emmet came to Schenectady in January, 1894, on the removal of the general office to that place, and was soon after made engineer of the lighting department, which position he still holds.

Mr. Emmet has taken out a great many patents protecting his inventions. Among these may be mentioned improvements in railway appliances, methods of insulating cables and of coil windings, anti-hunting devices for rotary converters, oil switches and a great variety of types of switches and fuse blocks. Mr. Emmet has also secured patents on air blast transformer construction, especially relating to the separate control of the cooling air for the iron laminations and for the copper conductors; oil transformers of large size, including a method of cooling by running water in a tubular secondary; also methods of cooling transformers by insertion of water vessels between the windings; a method of cooling by enforced circulation of oil; a method of supplying neutral current to a three-wire system by means of a rotary converter; a patent upon automatic regulators, etc., etc.

Mr. Emmet has been prominently identified with the establishment of the system of rotary converters for the distribution of power in cities for railway and lighting purposes. Among the first plants of this character were those of the Chicago Edion Company and

the Brooklyn Edion Company, Mr. Emmet being the directing engineer for the General Electric Company in both cases. The Brooklyn plant is the prototype of many of the existing large central power distribution schemes for railway lighting and power, such as the Metropolitan, Central London, New York Edison and Manhattan systems. The engineering for the General Electric Company around Niagara Falls has been in the hands of Mr. Emmet.

Mr. Emmet was perhaps the first to explain the principle of the parallel operation of engine-driven alternators and to demonstrate his theory by practice. He proved that the difficulties heretofore encountered were incorrectly assigned to the design and proportions of the dynamos; that the engines were the real source of trouble, and that almost any two or more dynamos of equal frequency and voltage may be successfully run in parallel if the engine governors are properly fitted with devices which will sufficiently retard governor movements for a brief period, and then freely yield to continued pressure, due to change of load.

Mr. Emmet is the author of a widely known pioneer treatise on alternating-current wiring and distribution. He has read a number of papers before the American Institute of Electrical Engineers (of which he is now a manager), the National Electric Light Association, and the Edison Association of Illuminating Companies. Mr. Emmet's contributions have been marked by great originality, a wide grasp of the subjects treated, and have been invaluable on account of his extended practical experience.

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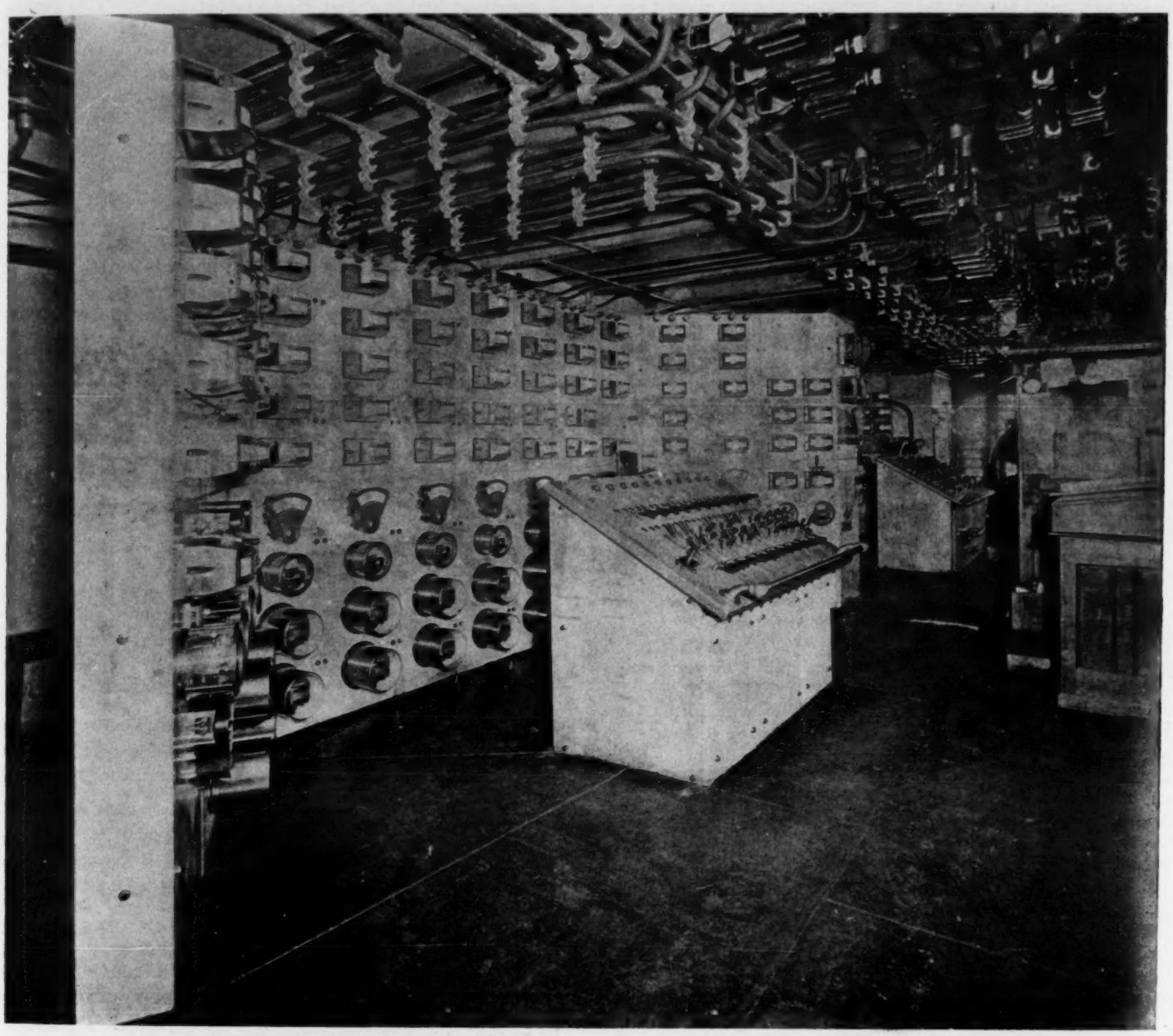
The Power House and Distribution System of the Metropolitan Street Railway, of New York.

THE interest of electrical men who will attend the Convention of the American Street Railway Association next week will probably center about the great power house of the Metropolitan Street Railway Company, located on the East River at Ninety-sixth Street. As this is the largest electric generating station yet put in operation, and the generating units contained therein are also the largest yet put in operation, considerable interest attaches to the performance of this plant. The economy obtained so far in the operation of the plant is probably not equal to what it will be ultimately when the plant is fully loaded, but is, nevertheless, very gratifying. For a full description of this power house, and especially of the switchboard and circuits of the power house and distributing system, readers of this article are referred to the ELECTRICAL WORLD AND ENGINEER, Vol. XXXV., Nos. 13, 14, 15, 16, 17, 19, 21 and 23, a series of eight articles on this subject by Mr. J. E. Woodbridge. These covered the ground so thoroughly that it is not necessary to go into any extended description of the plant here.

It contains at the present writing eight 3500-kw units and the plant is designed to contain three more, which are now being installed. These units are driven to Reynolds-Corliss vertical cross-compound condensing engines, which are supplied with steam from 72 B. & W. boilers located on three floors of the adjoining boiler room. Of course, all operations where it is possible are conducted by automatic machinery, including the handling of coal and ashes, stoking and the oiling systems of the engines.

The generators are 6600-volt, 25-cycle, three-phase machines, and the 6600-volt current is conducted directly to seven sub-stations by means of underground feeders. Before passing to the electrical equipment of the station it may be well to note that the coal consumption of this plant is reported by Mr. M. G. Starrett, chief engineer, to be 2.65 lbs. per kilowatt-hour. This is in actual all-day practice and includes steam taken by all the auxiliary engines, including those driving conveyers and stokers. The water used by the main engines per ihp-hour is given as between 13 and 14 lbs. in actual practice, which is probably as low, or lower, than in any electric generating station now in operation. The coal used is one-half buckwheat anthracite of a low grade, and one-half bituminous. Very careful records are kept of every detail in the operation of this plant. The anthracite is burned under half of the boilers and bituminous under the other half.



SWITCHBOARD OF METROPOLITAN STREET RAILWAY COMPANY, NEW YORK.

The electrical output of the station is controlled by means of oil switches with electro-pneumatic operation. Great precautions are taken, as was noted in the previous series of articles referred to, that a short-circuit or failure to interrupt the circuit at one point may not spread so as to cause other short circuits. The switch in each leg of each circuit is confined in a brick cell. Two switches are placed in series in each generator and feeder circuit to insure that the circuit can be broken at all times. Between each generator and the bus-bar there are two three-pole oil break switches in series. When these are opened they are both opened at once by the electro-pneu-

matic relay circuit-controlling switches. The accompanying engraving shows the generator controlling board at this power house in the foreground, with the feeder controlling board in the background. The only circuits brought to the controlling board are those of the low-pressure circuits which operate the electro-pneumatic valves, which in turn control the air to throw the switches. As said before, there are two switches in series for each generator, which are opened simultaneously, but in closing them to throw in the generator it is necessary to close one of the switches first, leaving only one to be thrown in at the instant of synchronism, as it would be difficult to know the time element of the two switches acting together and there might be considerable trouble through the throwing together of generators when not in synchronism, due to the attendant's inability to judge the time element.

The generators are grouped on four sets of bus-bars, each set being independent of the other sets to guard against trouble with one set of bus-bars interfering with the entire station. Feeders also are grouped on four bus-bar sections. An oil circuit-breaker, operated either automatically or by hand, is put in each individual feeder, and also in the circuit supplying each group. Thus there are four oil switches in every circuit between the generator terminals and the conducting feeders. The two or more feeders supplying any given sub-station are taken from different sections or groups on the feeder board, and as far as possible take different routes to the sub-stations which they supply, so that no sub-station draws its current entirely from one portion of the feeder board or from feeders running in the same conduit.

It is gratifying to note that the operation of the oil switches in this station has been very satisfactory, and that they have never failed to open the circuit in any emergency, although at times it is estimated that not less than 2000 amperes at 6600 volts were flowing at the time the circuit was broken.

The high-tension feeders connecting the power house with the sub-stations are naturally the weakest part of the distributing system because of the danger that a defect in one cable will cause a short circuit which will damage neighboring cables. Danger of shutting down any sub-station from this cause has been practically eliminated by the plan just mentioned, but, nevertheless, some other more than ordinary precautions have been found advisable in connection with these high-tension feeders in the conduits. Vitrified conduit seems to possess the requisite amount of heat-resisting material to best prevent the spread of short circuits from one cable to another. However, the most likely location for trouble is at the manholes, and here the high-tension cables are run straight through and are covered with a sheet steel case which is large enough to allow a one-half inch air space between the lead covering and the steel case. The case is made in two parts and held together with binding wire. Wooden bushings over the cable at the ends of the sheet steel protectors hold the case so as to maintain the one-half inch air space around the cable. This air space is found to be of value in preventing the spread of trouble from short circuits, and the casing, of course, tends to prevent mechanical damage. The high-tension feeders used on new work have a paper insulation 7-32 inch thick, it having been found that paper insulation stands the test of time better than rubber at this voltage. All feeders, transformers and other apparatus are tested at 25,000 volts for five minutes, after being put in place and before being put in service. The high-tension feeder cables are all of one size, and contain under one lead sheath three standard conductors equivalent each to a 0000 B. & S. gauge wire.

The seven sub-stations are equipped with a varying number of rotary converters of a capacity of about 1000 kilowatts each. In connection with each sub-station is a storage battery of about 25 per cent of the capacity of the rotary converters at the sub-station. This is for the purpose of taking momentary fluctuations, and it also carries the owl car-load when the alternating current part of the plant is shut down once a week for the cleaning of the high-tension switchboards. Rotary converters are run with plain shunt-wound fields, because by so doing the necessity of reactance coils is eliminated. The drop in voltage on the direct-current feeders is small enough so that series field coils which raise the voltage as the load increases, are not necessary. Later, when these rotary converters are installed they are tested to determine at what field strength their power factor is unity, and the field strength is always kept the same.

The efficiency of the distribution is given by Walter A. Pearson, electrical engineer of the company, as from 90 to 91 per cent. This comes very near the maximum efficiency that could be expected from the efficiencies of the various pieces of apparatus which enter into the distribution. This figure of efficiency just given is the difference between the readings of the wattmeters in the 6600-volt generator leads at the power house, and the wattmeters in the direct-current bus-bars at the sub-stations, and therefore includes the loss in high-tension feeders, transformers and rotary converters. The loss in the low-tension, 500-volt feeders is given as from 3 to 7 per cent on the different lines at various hours of the day. The total efficiency of the distributing system from the power house to the cars is therefore very high as compared to common American practice. These figures, of course, do not include what loss takes place through the current which is used in the charging of the storage batteries, and is not recovered again upon the discharge. As the relative amount of energy delivered to or from the storage batteries is small as compared with the total, this probably does not have any great effect on the total efficiency.

The task of keeping switchboard instruments calibrated on an electrical distribution of this kind is not a small one, as there are over 750 instruments in the power plant and sub-stations. Two men are kept constantly employed recalibrating and checking these instruments.

The output of this power house at present reaches about 2200 kilowatts at the highest point, which occurs a few minutes before 7 o'clock each evening.

The Influence of Polyphase Apparatus on the Design of Railway Power Stations—I.

BY J. E. WOODBRIDGE.

THE designer of a railway power plant containing direct-current generators need pay little or no attention to the electrical apparatus when laying out his building. So far as the space which they occupy is concerned, the generators are usually a part of the engines, hence the provision of sufficient space for the engines allows for the generators. The engine foundations also, as a rule, support the generators. Outside of the generators the electrical apparatus in a direct-current station consists of a switchboard, which generally is, and can be, placed almost anywhere alongside a wall.

In a polyphase railway plant, on the contrary, the electrical apparatus includes exciters, transformers, converters, blowers, etc.; and the switchboard and station wiring become much more elaborate, for which reasons a much better plant is obtained by modifying the structural design to suit the electrical apparatus to a far greater extent than is necessary in direct-current plants.

As the effect of these electrical auxiliaries on the structural design are not generally familiar to engineers of direct-current plants, the following comments may be of interest to the many engineers of such plants who contemplate polyphase and rotary converter extensions.

SUB-STATION DESIGN.

As the influence of the electrical apparatus on the structural design is not disturbed by steam considerations in sub-stations, these will be considered in advance of the main stations.

In order to illustrate most clearly the influences of the electrical apparatus on the station design, actual designs will be presented, based on assumptions fitting as nearly as possible usual practice.

The sub-station most often required in the present state of the art is used for supplying a single section of a long interurban or suburban line. For determining the size of the apparatus in the sub-station let us assume that this line gives half-hourly service, with cars each equipped with four motors rated at about 50 horse-power each. For such service, supplied from sub-stations about 10 miles apart, a converter of about 300 kilowatts will be required in each sub-station, and a second machine of the same size may well be put in as a reserve, and to help at times of peaks caused by excursions, etc.

CONTENTS OF SUB-STATIONS.

We will assume, then, that the sub-station contains one or two 300-kw converters, and is made of sufficient size to accommodate a third and located in such a way that it may be extended in case of the addition of more converters or other apparatus, such, for instance, as boosters, lighting motor-generator sets or other machines. We will assume that each converter is supplied through three air-blast step-down transformers; the group of transformers having a slightly larger rated capacity than the converter in order to provide for the internal losses of the latter. On this account each transformer will

be rated at 110 kilowatts. The station will also contain a reactive coil connected in the low-tension circuits between each group of transformers and the corresponding converter, in order to assist the compound winding of the converter to give automatic voltage regulation. Since 25 cycles is recognized as a desirable frequency for rotary converter work, we will assume that the system operates at this frequency. Since duplicate lines are not often used for such small sub-stations, we will assume that there is one high-tension, three-phase, incoming line with accompanying high-tension lightning arresters. The voltage most commonly adopted for such a system is the highest which can be safely generated in the usual sizes of alternating-current generators without recourse to step-up transformers. This voltage is between 10,000 and 15,000 volts. We will assume that our sub-station operates at some pressure between these limits. For the air-blast transformers blowers will be required. Centrifugal steel-plate blast fans with downward discharge, standing over a blast box extending under the transformers, are generally used for this purpose. We will assume that these are direct driven by induction motors, as induction motors are preferable to direct-current motors for this purpose, since they require no starting boxes with low-voltage release attachments, which automatically shut down direct-current motors every time the current supply fails momentarily, as in case of a station blowout.

SUB-STATION SWITCHBOARD.

The sub-station switchboard needed for these two machines consists of two alternating-current high-tension converter panels; two alternating-current low-tension converter panels, and two direct-current converter panels. There are also some direct-current feeder panels, usually two in number, one feeding the trolley wire or third rail in each direction. We will assume that each high-tension converter panel is equipped with automatic oil switches, removed from the panel and inclosed in brick compartments; these switches being operated by hand, but fitted with relays and tripping coils for opening automatically in case of overload, thus doing away with the need of fuses.

ARRANGEMENT OF SUB-STATION APPARATUS.

The apparatus outlined above can be arranged in an almost infinite number of ways, as may be seen by cutting out cards representing to scale the plans of the various pieces of apparatus and grouping these in various ways. Advantages for and against many of these arrangements can be found. After studying the expense of many of these arrangements and the comparative ease of operation of the sub-station, the grouping shown in Fig. 1 appears preferable for a sub-station of this kind. The machines here shown are all to scale for apparatus made by the General Electric Company. From this plan and the elevations shown in Figs. 2 and 3 it will be seen that the switchboard panels are arranged across one end of the sub-station room, with oil switches in brick compartments on the same floor level behind the panels. The step-down transformers are arranged in a single line along the left-hand wall of the station as one faces the switchboard, each converter being immediately opposite its own group of transformers on the other side of the station. The panels in the switchboard are arranged in the order which has become customary in American practice; that is, the sequence of the panels from left to right is the same as the sequence of the connections on the panels in the power circuits through the sub-station, beginning with the high-tension alternating-current incoming power, and ending with the outgoing direct-current feeders. It will readily be seen that the route of the power through this sub-station is a sort of loop, starting at the entrance of the incoming line, passing down through the high-tension bus-bars to the converter oil switches, thence down the left-hand side of the sub-station to the step-down transformers, from them through the reactive coils and straight across the station to the converters, from them back along the right-hand side of station to the switchboard, from the direct-current feeder panels of which the power passes out in any desired direction. Thus there is no crossing or intermingling of the different classes of wires, which are quite numerous in sub-station work.

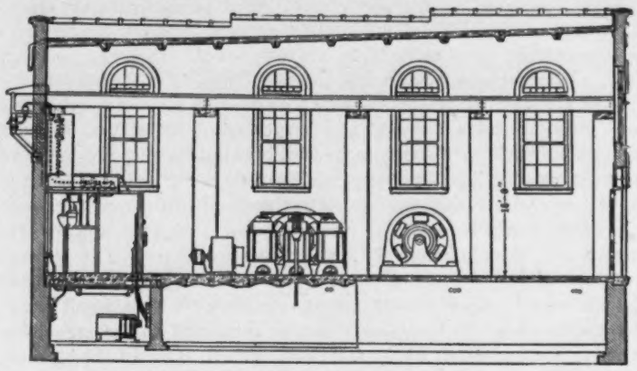
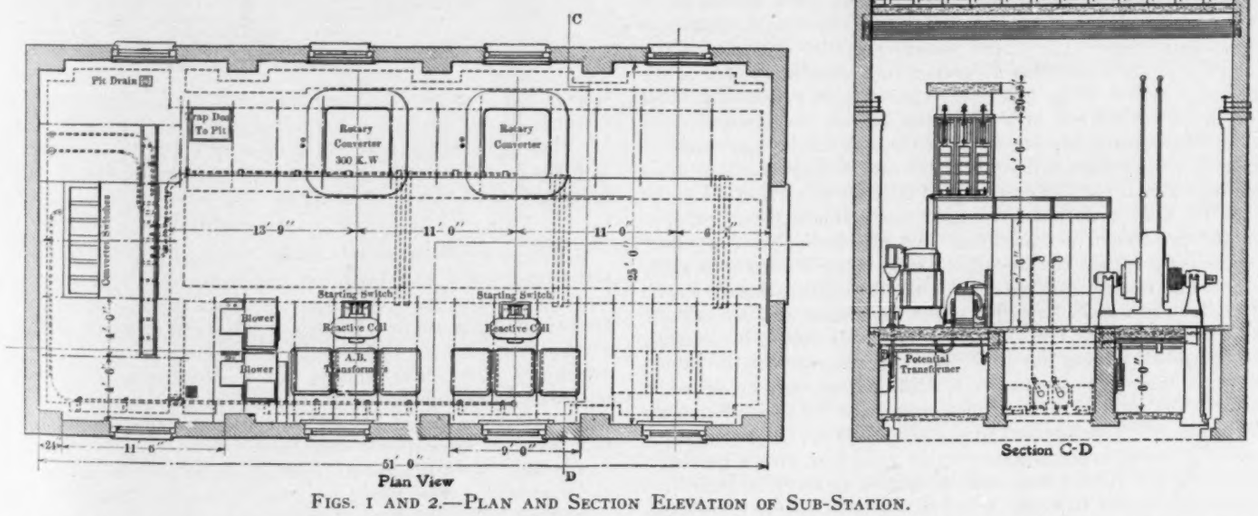


FIG. 3.—SECTION OF SUB-STATION.

It should be noted that the low-tension alternating-current panels are in this station divorced from the main switchboard, and located directly on the route of the power from the transformers to the converters, these panels being mounted either on the floor in front of the reactive coils or, preferably, on top of the latter. These panels in the system described are small affairs, each carrying a throw-over switch for starting the converter by means of alternating currents at a low voltage derived from intermediate taps in the transformer windings. There are no instruments or other devices than switches on these panels, all indicating, synchronizing and similar alternating-current apparatus being mounted on the high-tension converter panels in the main switchboard.

It should also be noted that in this sub-station the direct-current panels are single pole, thus doing away with the danger of short circuits or any bad flashes occasioned by working behind the direct-current switchboard when the plant is in operation. The polarity of the feeder panels is, of course, the same as that of the trolley, which is customarily made positive for electrolytic reasons. The polarity of the converter panels is made the same, making the whole direct-current switchboard of positive polarity. On this account the series winding on each converter is connected on the ground or negative



FIGS. 1 AND 2.—PLAN AND SECTION ELEVATION OF SUB-STATION.

side. The negative and equalizer and series shunt switches are in this station mounted on a small panel fixed to the frame of the converter, thus doing away with the pedestal customary in direct-current generating stations. These switches are all of ground potential, and hence may with perfect safety be mounted on the frame of the machine, which is, or should be, grounded. This switch panel is mounted on the left-hand side of the frame of each converter as looked at from the commutator end, the commutator being turned toward the central passage of the station, as one of the sectional elevations shows. The switches are therefore visible from the switchboard attendant's usual position. The field break-up switches are also mounted on the commutator front of the machine, where they will be visible from the attendant's usual position. The alternating-current starting switches are also visible from this position, and easily accessible with a few steps.

Every device which the attendant handles in the ordinary course of operations faces the central passageway of the station running from the switchboard to the main door between the reactive coils and the converters. This central passageway of the sub-station is made sufficiently wide for the removal or replacement of the converter near the switchboard, between the converter near the door and its reactive coil, if such removal ever becomes necessary. The blowers are located near the switchboard, where their stoppage will be noted by the sound. Each blower motor is equipped with a small panel, by means of which the blower can be connected to the step-down transformers of either of the rotary converters. One of the blowers, that nearer the wall, is fitted with an air intake from out of doors, thus running the transformers at a considerable lower temperature during a large part of the year. The lightning arresters are located immediately below the line entrance, in such a position with relation to the converter oil switches that a line oil switch can be erected and connected into the line immediately below them in case the lines are duplicated, thus calling for a switch in each. The lightning arresters are carefully kept away from the floor level, where they might be a risk to visitors. A slate covering over the high-tension bus-bars serves, however, as a convenient flooring for the sub-station attendant when cleaning the arresters. Fireproof barriers are built into the wall between the several single-pole arresters to prevent an arc set up by violent lightning discharges from jumping from one arrester to another.

CONSTRUCTION OF BUILDING.

It will be noted from the plans that the sub-station throughout is of fireproof construction. It has been customary in the past to house railway sub-stations in wooden structures, but this custom is dying out. Sub-stations are, as a rule, located where there is little or no fire protection, and are incapable of protecting themselves as are generating stations. The added cost of fireproof construction per kilowatt capacity installed is no greater in a sub-station than in the generating station. The loss of revenue due to a line being shut down in case of the loss of a sub-station by fire warrants the added cost of the non-combustible construction. Where a sub-station is combined with a car house or other structure it should be isolated from the latter if possible or separated by fire wall. Since the duties of the sub-station attendant are light, many roads prefer to combine the sub-station building with the attendant's quarters; since in this case one man can attend the sub-station during both shifts of the usual electric railway day. The attendant's quarters should not be built as a second story over the sub-station for two reasons, one being the heat of the sub-station apparatus during the summer season, the other being the fire risk. As a rule, the cost of land is low where these sub-stations are located, and quarters on the other side of a fire wall with a fire door between these quarters and the sub-station are to be advised. In case the sub-station is located at a point of traffic importance it may be combined with a passenger station, the sub-station attendant being able to serve as ticket and baggage agent. In this case a fire wall should divide the waiting room, ticket office, etc., from the sub-station proper. The quarters of the sub-station attendant may in this case be made a second story over the ticket office, waiting room, etc. Such a design is indicated in Fig. 7.

For convenience in installing the apparatus, the cost of even a hand crane is not usually considered as warranted in such small sub-stations, but the main door should, if possible, be toward the track, so that the machines may be readily skidded into place.

BASEMENT PLAN.

It will be noted from Figs. 1, 2 and 3 that there is below the sub-station floor a U-shaped excavation, one leg of the U being under the transformers, the bottom of the U being under the switchboard and the other leg under the converters. This excavation serves in part as a blast box, in part as a wire tunnel, and in part to receive the field rheostats, starting rheostats, switch operating mechanism, trip coils and other switchboard details, which are preferably placed out of the way below the floor level. This excavation should be made of ample depth for convenient work, one of the greatest mistakes in many sub-station designs being the lack of sufficiently large pits or basements. The transformers in such a sub-station are preferably wired entirely from the blast box, both the high and low-tension wires entering the transformer casing from below, no wiring being brought in at the top. This greatly improves the appearance of the station and reduces somewhat the cost of installation. The primary windings of the transformers are provided with taps for varying the ratio of transformation and thereby the resulting direct-current voltage. These taps are at the bottom of the transformers, and may require occasional changes of connections. Ample head room should be allowed for working at these details, and also at the several low-tension connections from below. The blast box is made of ample width to carry the reactive coils, which are also air cooled and preferably wired from the bottom, all wiring to the low-tension alternating-current converter panels which stand on top of the reactive coils being carried down through the reactive coil casing, thus keeping all wiring around transformers, reactive coils, etc., out of sight.

Entrance to the blast box can be made by means of a door from the pit under switchboard end of station, instead of by means of a

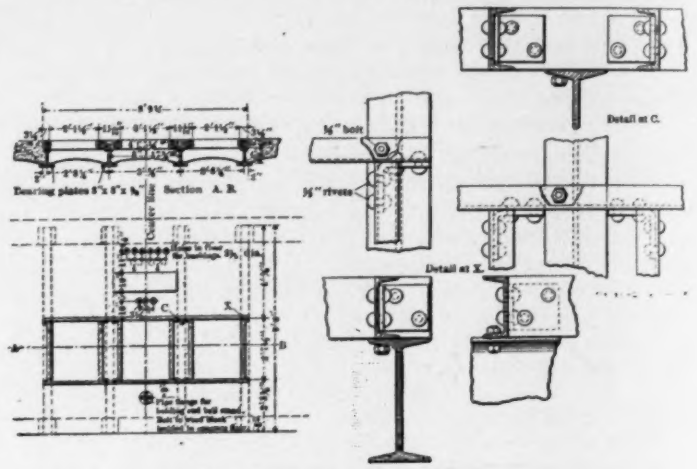


FIG. 4.—DETAILS OF FRAMEWORK.

trap door, as has been the usual practice in the past. If there is sufficient room this door may be provided with a small equalizing chamber, thus avoiding the difficulty of opening a door of reasonable size in order to enter the blast box, as well as reducing the air leakage by virtue of the two doors in series.

FLOOR CONSTRUCTION.

It will be noted that in this station the usual wooden floor around transformers and over blast box has been replaced by a non-combustible construction of steel floor beams and concrete arches, a steel framework being utilized to support the transformers as well as to form a frame for the openings in the concrete beneath them. This framework is shown in detail in Fig. 4. No steel work of this kind should be located under the reactive coil, as the latter in some forms has an open magnetic circuit projecting downwardly, which will heat any iron work placed immediately under the coil. A cast-iron frame may be set around the opening under each transformer, but the combination steel frame for three transformers shown in Fig. 4 is preferable if suitable steel sections can be obtained without too serious delay. The floor beams in this part of the station may in many cases be made of discarded T or girder rails. A similar floor construction is to be advocated under and behind the switchboard in place of the usual wooden beams and planking.

A 12-inch slot is left behind the panels for the passage of all cables, rheostat operating chains and switch operating levers through the floor, this slot being preferably closed after the installation of the board by slate slabs, cut away to clear the parts passing through the

floor. This slot is surrounded by a steel frame, to which the angle or T bars behind the switchboard panels are fastened through fibre insulation, which prevents a short-circuit in case the positive direct-current bus-bars or leads upon the panels become crossed with the switchboard steel work.

It should be noted that all alternating-current connections to the alternating-current panels are made through potential and current instrument transformers, the secondary circuits of which are solidly grounded, so that there is no danger of high-potential currents reaching the switchboard frame and no necessity of grounding the latter in order to prevent high-potential shock to any one touching it.

Some engineers prefer building a square foundation pit under each converter, connecting these pits by tile ducts, but the writer advocates the continuous pit indicated in the sub-station here described. This pit allows the attendant to approach the machines from below, and gives easy access to the brushes and brush holders or other parts beneath the commutator while a machine is running. With an individual pit under each machine the attendant must climb through the machine frame to reach parts beneath it, thus necessitating the shutting down of the machine. The opening under the machine frame should not be floored over, since such a floor, with the bushings and cables passing through it, is soon covered with an accumulation of oil, waste and dirt, which should not be allowed in any sub-station, and which it is very difficult to avoid. Without the floor, this accumulation falls to the bottom of the pit, which may be readily cleaned at any time. The converters rest on the side walls of the pit, and any concrete, brick or other arched floor may be readily bounded at the converter openings by a construction similar to that shown in Fig. 5, where a channel section is used at the sides of the openings of sufficient height to reach the floor level and serve in part as a stiffener for the converter base. Since the converter frame should be grounded, there is no further need of the wooden foundation which has been handed down from the days of the arc machine. There seems to be no good reason for elevating the bases of converters above the level of the finished floor, although tastes differ on this point.

WIRING OF SUB-STATIONS.

Although these small sub-stations usually contain no cranes to interfere with overhead wiring, it is preferable to carry all wiring below the floor for the sake of appearances. The high-tension wiring from each coil switch to the step-down transformers may consist of

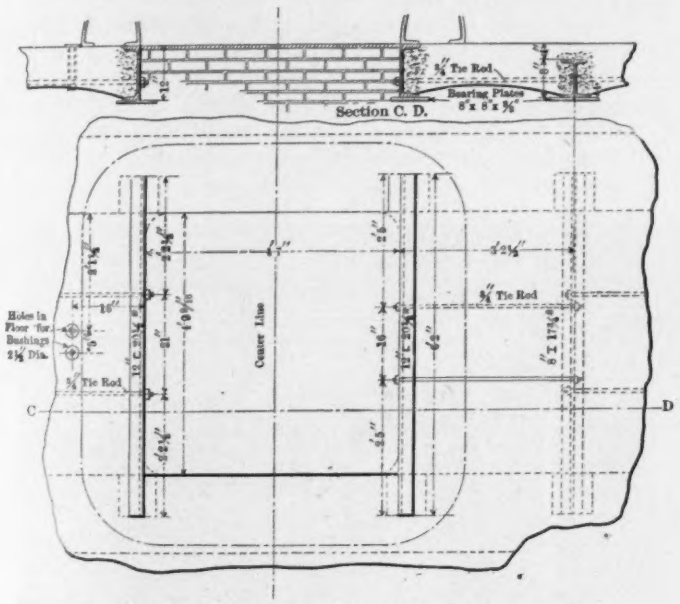


FIG. 5.—DETAILS OF CONSTRUCTION OF CONVERTER PIT.

either three single conductors, rubber covered to a suitable thickness and braided, or one triple-conductor cable, lead covered, with end bells. The latter is probably the preferable arrangement, as the number of cables becomes quite large when the sub-station extends, unless the leads are grouped in triple-conductor cables. Lead-covered cables, with rubber insulation, can be made satisfactory for small conductors at this voltage, in spite of considerable opinion to the contrary. A triple-conductor lead-covered cable is preferable to three single-conductor lead-covered cables. A triple-conductor high-tension cable for 10,000 volts or over should not be run in the sub-station basement without lead covering, owing to dampness, which is bound to exist in that part of the basement outside of the blast box. On account of the continual current of air through the blast box, this part of the station may be depended upon to be dry, unless water actually stands in it. It might be well to note here that careful attention should be given to prevent water from standing in this chamber under any circumstances, since the insulation of the apparatus is liable to serious injury if operated in this way. From the step-down transformers and reactive coils to the converters the leads pass through tile ducts, for which reason they had best be lead covered, although of low voltage. There is, however, some difference of opinion on this point, some engineers preferring rubber covered

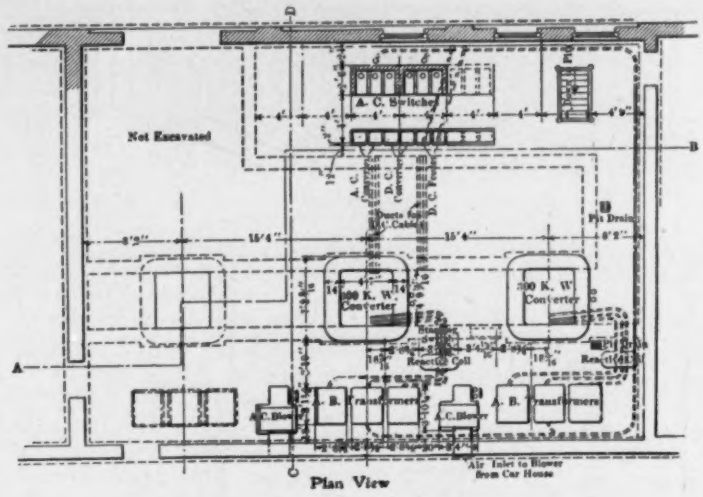


FIG. 6.—PLAN PROVIDING FOR EXTENSION.

and braided cables in such locations, provided the ducts are well joined and sloped for drainage. The direct-current cables from the machines to the switchboard need not be lead covered, since they are of low voltage and do not run through ducts. They are best run in the usual porcelain rack insulators. The negative and equalizer bus-bars are run in the pit under the converters, and may well be of bare copper bar not insulated with any care, since they are on the ground side of the circuit. The leads from the switches on the machine frames to the negative and equalizer bus-bars may also be of bare copper strap if desirable.

ROOM FOR EXTENSIONS.

It will be noted that the arrangement outlined above locates all machines in line, so that the sub-station can be extended by simply adding to the length of the building, without rearranging the apparatus. This feature is one of the most important considerations in station arrangement, since the traffic on a road supplied by such a station is morally certain to increase, as has the traffic on urban roads, to an extent never contemplated at the time they are started. One of the greatest faults of almost all arrangements of the apparatus, admirable in all other ways, is the inability to extend satisfactorily. It may be argued that the arrangement outlined above runs the switchboard across the station, while the machines line up lengthwise of the station, thus calling for an extension of the building in two directions when more machines are installed. The width shown in Fig. 1, however, provides space for sufficient switchboard and oil switches for four converters and duplicate incoming lines with a reasonable number of direct-current feeders. This is as many machines as the usual interurban sub-station will contain. If the load becomes too great for four machines, they should be replaced by larger ones, or more sub-stations should be installed at intermediate points.

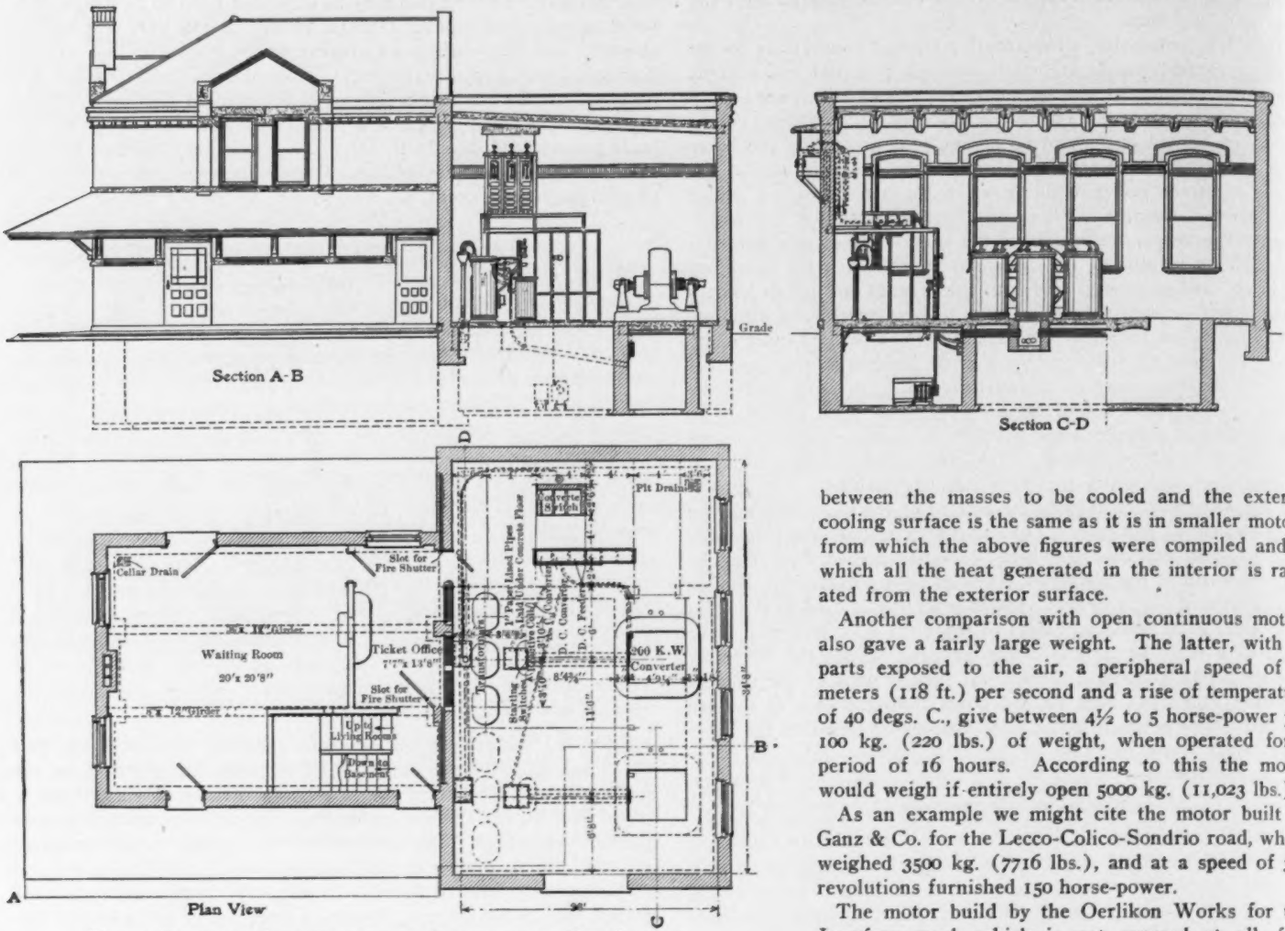
It is difficult to find a satisfactory arrangement with the switchboard paralleling the lines of machines, owing to the depth of the board and the fact that it becomes much shorter than the rows of machines, thus wasting some space. Fig. 6, however, shows what can be done with all lines of apparatus of this character arranged in parallel lines.

SUB-STATIONS WITH OIL-COOLED TRANSFORMERS.

Sub-stations containing converters smaller than 300 kilowatts operate, as a rule, with oil-cooled transformers, since in small sizes the oil-cooled transformers can readily obtain a large ratio of surface to

volume, and the cost of blowers is not warranted in small installations.

Figs. 7, 8 and 9 show an arrangement of apparatus in an oil-cooled sub-station with two 200-kw converters and appropriate transformers, reactive coils and switchboard.



FIGS. 7, 8 AND 9.—ARRANGEMENT OF APPARATUS IN SUB-STATION.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds Up to 125 Miles an Hour.*

BY WALTER REICHEL.
(Chief Engineer Siemens & Halske Company.)

THE ELECTRICAL EQUIPMENT OF THE CAR.

AS has been previously stated (Sept. 7, 1901, page 367), each motor has to satisfy the requirement that when the car is going at the regular speed under normal conditions, 250 horse-power must be furnished and that at starting three times that power, or 750 horse-power, must be developed. Furthermore, the motors must be supported between the wheels, and the latter being 49 inches (1250 mm.) in diameter, sufficient space must be left between the motors and the roadbed, and also the springs of the car and the motors. The latter condition is the more important as it determines the size of the motor, and consequently its weight and maximum output. This is so extraordinarily large that when compared with existing types of dynamos and motors having the same output the weight and size would be greater than the space would permit. Allowing a rise of temperature of 75 degs. C., good, enclosed railway motors have an output of about 1.7 horse-power for each 100 kg. (220 lbs.) in weight for any considerable length of time for a peripheral speed of 12 meters (39.3 ft.) per second, or for a speed of 36 meters (118 ft.) per second, about 5 horse-power. For 250 horse-power the weight of the motor would therefore be 5000 kg. (11,023 lbs.) under the supposition that the relation between the masses to be cooled and the exterior cooling surface is the same as it is in smaller motors, from which the above figures were compiled and in which all the heat generated in the interior is radiated from the exterior surface.

Another comparison with open continuous motors also gave a fairly large weight. The latter, with all parts exposed to the air, a peripheral speed of 36 meters (118 ft.) per second and a rise of temperature of 40 degs. C., give between 4½ to 5 horse-power per 100 kg. (220 lbs.) of weight, when operated for a period of 16 hours. According to this the motor would weigh if entirely open 5000 kg. (11,023 lbs.)

As an example we might cite the motor built by Ganz & Co. for the Lecco-Colico-Sondrio road, which weighed 3500 kg. (7716 lbs.), and at a speed of 300 revolutions furnished 150 horse-power.

The motor build by the Oerlikon Works for the Jungfrau road, which is not encased at all, furnishes 120 horse-power, and weighs 2200 kg. (4850 lbs.). These figures show that a motor weighing less than about 4000 kg. (8818 lbs.) will not only be too small, but it cannot operate for any great length of time without heating unduly. It has been suggested to employ some artificial means for cooling, as it was not deemed advisable to cool the motor by removing the casing, on account of the presence of a great deal of dust and moisture, and, furthermore, the outside area is not sufficient to dissipate the heat.

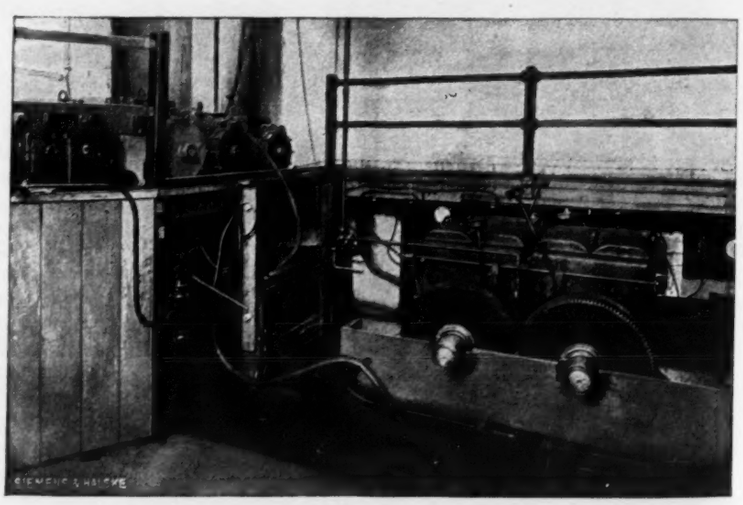


FIG. 10.—EXPERIMENTS WITH GEAR WHEEL TRANSMISSION.

The car wheels are to have a diameter of 1250 mm. (49 inches), and the motor, which is to have six poles, will have a speed of about 900 r. p. m. This permits the motor to be mounted directly on the

*The first part of Mr. Reichel's article appeared in our issue of Sept. 7. The delay in presenting the following portions has been due to late receipt of the remaining manuscripts and illustrations, which only arrived in time to be available for the present issue.

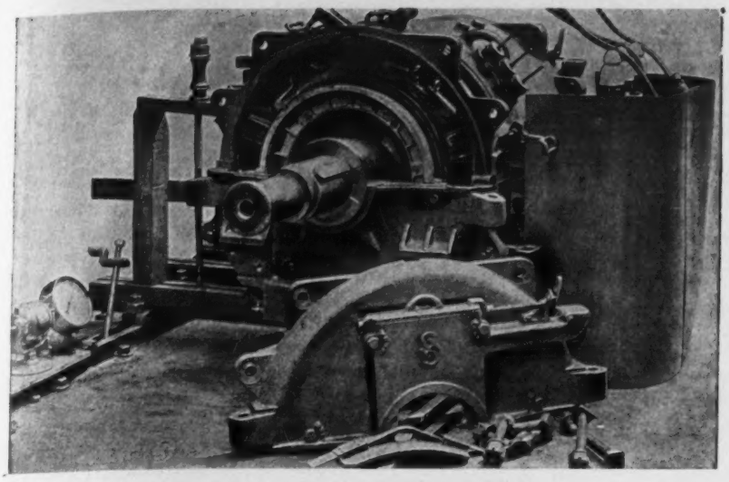


FIG. 12.—MOTOR OPEN, WITH TOP BEARING REMOVED.

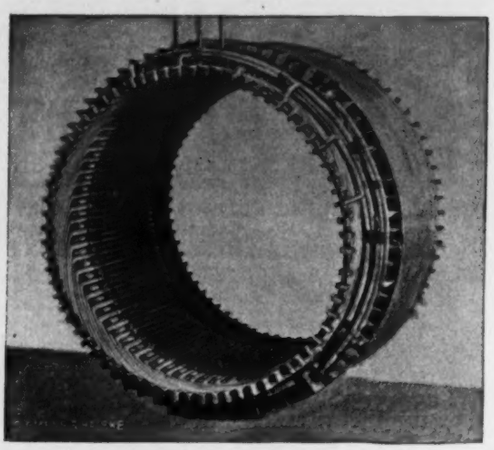


FIG. 11.—THE STATOR.

axle, without the use of any gear wheels. That this is possible, even at a train speed of 25 meters (82 ft.) per second, has been demonstrated, but a description of this would lead us too far in this article. Fig. 10, however, shows the arrangement which transmitted, without materially heating the gears and the oil projected in streams between the gears by means of air pressure, 120 horse-power for three hours at a speed of 850 r. p. m.

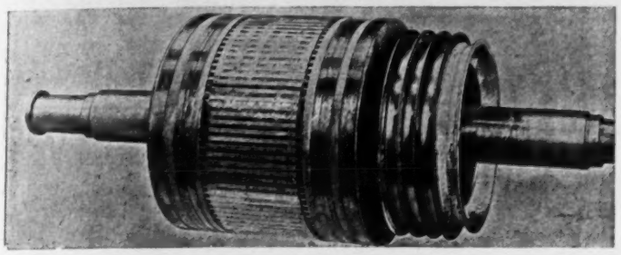


FIG. 14.—THE ROTOR.

After it was decided, therefore, to mount the motor directly on the shaft, the question came up as to whether it was advisable to employ springs similar to those used on the B. & O. locomotives, and the motors furnished by Ganz for the Lecco-Colico-Sondrio road, using a hollow shaft. On account of the great peripheral speed at the bearings, however, and the fact that the shifting of the axis of the hollow shaft with respect to the running axle occasioned by the use of springs, might cause disturbances at such high speeds, it was not deemed advisable to use springs.

The revolving part of the motor or rotor, was therefore firmly mounted on the shaft by means of a key, and the stationary part or stator was also mounted on the shaft without the use of springs.

The core of the stator is undivided, as shown in Fig. 11, as splitting the same in the case of a six-pole motor would necessitate too

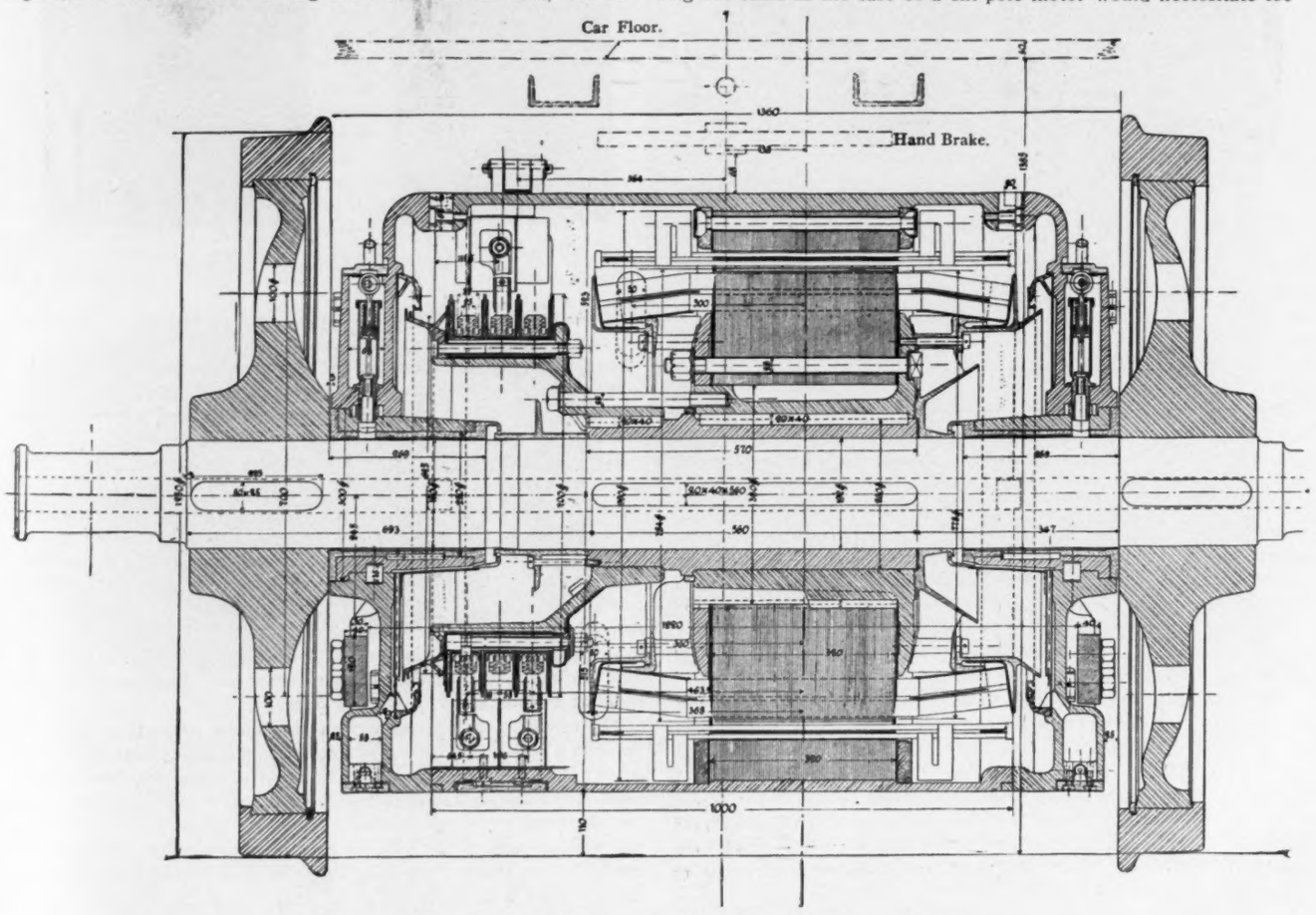


FIG. 13.—LONGITUDINAL SECTION OF HIGH-SPEED RAILWAY MOTOR.

many connections between the two halves. The exterior casing is made of cast steel, and in order to be capable of dissipating the heat efficiently, it is smooth on the inside and closely fits the core of the stator. It is divided into two parts, as are also the bearing covers, so that in case it is necessary to make repairs on the bearings or stator, they can be reached easily.

In Fig. 12 one of these covers is removed. To the lugs of the lower bearing covers flat iron pieces are bolted, which transmit the turning movement of the motor to the truck by means of springs. The bearings consist of heavy steel outer boxes, in which bronze plates, lined with white metal rest. The bearings are lubricated by means of oil and wick, and this method has proved itself very satisfactory. The oil is thrown down by means of oil rings into special compartments in the lower bearing covers. The motor is wound for six poles, there being 90 slots in the primary and 72 in the secondary.

In determining the winding of the motor the following had to be taken into consideration. The heating of the primary core is dependent upon the number of pole changes and the saturation, and as the number of pole changes is given, upon the cross-section of the core. This must be made quite large so as to reduce the heating; that is, the width being given, the radial dimension must be made large. If, now, the primary, with its large radial dimension is laid on the outside, then the diameter of the rotor is small and consequently also the turning moment. It is far better for the more profitable utilization of the space, to put the primary on the inside and make it constitute the rotor. The secondary, which only during the starting and at full speed has a very small number of pole changes, may have a considerably smaller radial dimension than the primary.

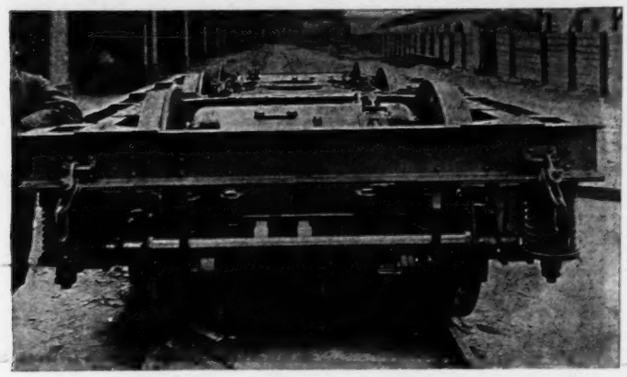


FIG. 15.—MOTOR MOUNTED ON TRUCK.

This will give a fairly large diameter of the rotor (in the motors already constructed about 9 cm., or 3½ inches), and there remains for the primary core considerable depth in the radial direction with the assurance of a low saturation. The rotor in this manner will have a diameter of 780 mm. (30.7 inches), while the over-all diameter of the motor is 1050 mm. (41.3 inches).

The motor is so wound that the primary pressure of 1150-1850 volts is carried to the rotor of the motor. For this purpose three collector rings are affixed at one end, which are made of good bronze and are insulated from each other by mica sheets which project considerably, as seen in Fig. 14. Eight carbon brushes make contact with each of the rings. The brushes are fed forward by means of springs, and in order to keep the brush holders a considerable distance apart from each other, they are distributed all around the periphery. They can be reached from the outside through small holes.

The core of the rotor consists of a number of iron plates, each of which is stamped out of a solid piece of sheet iron and all the plates are firmly held together.

The winding of the rotor, Fig. 14, is of the continuous-current bar winding type, as in this winding the ends of the various coils may be best protected from the action of centrifugal force by tightly-wound wire bands. The slots are insulated by means of mica, and wooden wedges protect the coils from flying out.

The winding of the stator is of the ordinary alternating-current type, and the core consists of a number of separate iron sheets joined together. The three primary and secondary leads are insulated from the frame wherever they pass through it by rubber bushings. Fig. 15 shows a motor mounted on the truck.

Automobile Storage Batteries.

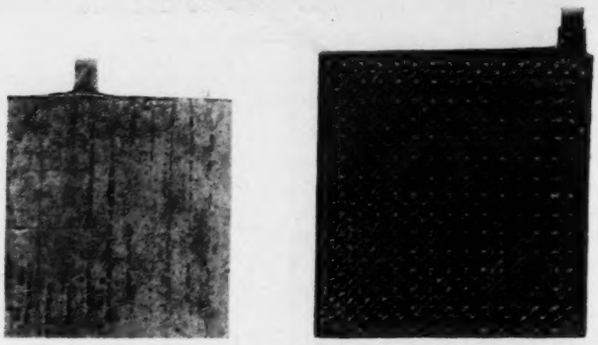
WE present herewith descriptions in detail of a number of storage batteries now available for automobile work, the descriptions having been prepared from information furnished by the manufacturers of the various batteries considered. The statements of performance thus come from the makers themselves, and while we do not doubt that all claims are made in good faith, due allowance must naturally be made for ultra-conservatism on the one side and enthusiasm on the other. The information herewith given, however, is substantially within the range of fact, and presents in concise form the main differences between the batteries considered. With a few exceptions all of the American automobile batteries now on the market are described, only a few manufacturers having denied the request for information concerning their products. The Edison storage battery is not included for the reason that a description of it has recently appeared in these columns, and no further information is available relating to its construction and performance.

As will be noted, data of a number of the batteries have been reduced to the basis of a three-hour discharge. Not too much stress should, however, be laid upon a comparison of different batteries on this basis in the absence of information as to corresponding durability. In other words, such a comparison is not conclusive unless each battery is designed with a view to give efficient results at that particular rate of discharge.

THE SPERRY BATTERY.

The Sperry battery is an improved form of the Planté type of lead-lead battery, but so designed and constructed as to be free from the difficulties that have attended the use of the applied sponge plate.

The grid is made of thin, pure sheet lead, which is corrugated horizontally. In the bottom of the hollows formed by the corrugations numbers of small trapezoidal holes are punched; the punch also cuts



FIGS. 1 AND 2.—SPERRY BATTERY.

diagonally across the trapezoid, and instead of making a clean hole, fins are left which project on either side of the plate. The whole plate when punched resembles a corrugated grater, except that the fins are longer, and triangular in shape. These projections are then spread wider apart so that a pressure on the plate will cause them to bend down in a direction away from the holes from which the fins project.

The material which is to become active is spread in the form of a powder on both sides of the grid, filling up the corrugations and being in sufficient quantity to make a flat plate of usual thickness after press-welding. The whole is then subjected to pressure—about 1000 lbs. per square inch of surface—which forms it into a solid mass. The material is bound to the grid by being pressed together into a continuous mass, which is on both sides of the grid and is welded through the multitude of small holes, thereby riveting itself in the grid. Additional hold is furnished by the fins, which bend down and are clinched over the active material and thus retain the material at the surface.

The retention of the fins and riveting under pressure of the powder into a solid mass cannot be successfully accomplished with every form of material to become active, but it is stated that the material used in the Sperry battery welds up strongly in the press, and after the chemical formation, becomes hard like soapstone. This active material consists of 80 to 85 per cent of finely divided pure lead obtained by dissolving a precipitation as explained in the description of the chloride battery, to which is added 15 to 20 per cent of lead oxide. These are thoroughly mixed, and to the mass thus formed is

added about 1-25 of a compound of alkaline salts and other ingredients.

The alkaline salts and the other ingredients are themselves inert, and their function is twofold: First, to render the material porous by dissolving out when the plate is "formed," leaving numberless pores throughout the mass, and, second, they have the peculiar property of causing the mass to harden on forming instead of soften, as is the case with pasted or other plates formed by the Planté process.

The composition of the active material used, its method of application, and the formation in the Sperry battery, are such, however, that trouble from disintegration and dropping away of active ma-

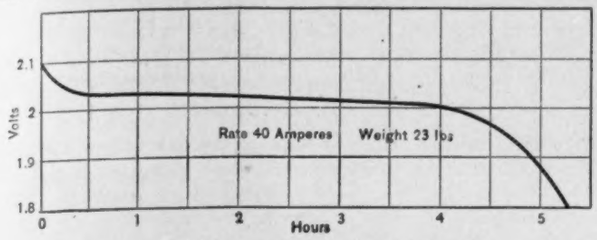


FIG. 3.—DISCHARGE CURVE, SPERRY BATTERY.

terial is obviated, and the makers claim, and their tests seem to indicate, that the plates are extremely hard, solid and durable. The corrugation of the grid horizontally allows proper expansion and relieves the plate of any tendency to buckle. As an additional precaution, however, Mr. Sperry has devised the pyroxylin coating which is applied to the outside of the plate and covers it, passing down one side, under the bottom of the plate and up the other side. It is evident that if any active material should be loosened by any extraordinary circumstances, it would not be able to drop off the plate, being held in position by the outside coating. If a particle of material should by any chance drop off, it will still be retained in the pyroxylin envelope and would not be able to short-circuit the battery.

This covering is made of open mesh cotton cloth, such as "cheesecloth," which is chemically treated, forming a cellulose nitrate which is termed "pyroxylin." This compound is of the same general character as gun cotton, which is a high explosive. The addition of a small quantity of nitro-benzol renders it inert.

To the sheet of pyroxylin thus formed is applied a coating of pure cellulose. This is formed by treating fiber—in which the non-cellulose constituents belong to the class of aldehydes—with sulphurous acid. The fiber after being washed is again treated with sulphurous acid, leaving pure cellulose. This is then pulped and applied under pressure to the pyroxylin sheet. The envelope when finished is ribbed vertically so that the elctrolyte can circulate freely along the surface of the plate after passing through the envelope.

The jars in which the elements are placed are of the hard rubber variety, but different from the usual hard rubber jar in that they

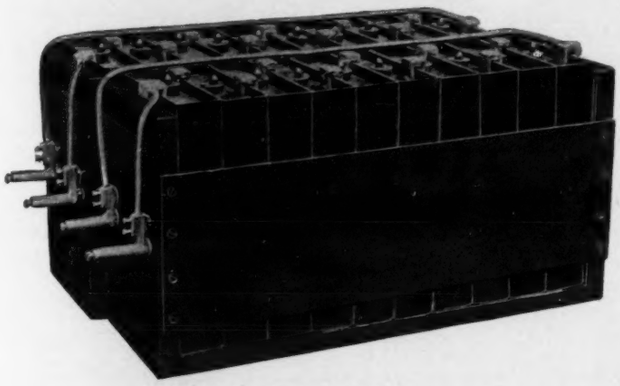


FIG. 4.—SPERRY BATTERY.

have a series of ribs capped with soft rubber extending across the bottom of the cell. On these soft resilient ribs rest the plates which are in this way relieved from excessive shock or jar. The separators are the usual thin, perforated, ribbed, hard rubber.

Fig. 3 shows a curve of discharge of the Sperry battery taken from 44 cells in series. These cells weigh 1005 lbs. gross or 23 lbs. each. The discharge rate was nearly 40 amperes and the average voltage 1.975. The curve shows the unusual results of 1.75 amperes, 9.187 ampere-hours, and 18.15 watt-hours per pound gross weight at 5¼-hour discharge, giving at this excessive rate of discharge 40 lbs. per horse-power-hour, corresponding to an energy sufficient to raise its own weight against gravity at sea level about 9 miles.

This is equivalent to 2.65 amperes, 7.95 ampere-hours, 5.03 watts and 15.09 watt-hours per pound at the 3-hour rate. There are several sizes of these cells manufactured, the two principal ones being 2 inches by 7¼ inches by 10½ inches, and weighing 18 lbs. gross, and 3 inches by 7¼ inches by 10½ inches, and weighing 22.8 lbs.

A number of life tests have been made on this battery, both in laboratories and on vehicles and in practical work. One vehicle has now made about 7700 miles with the batteries with a loss of 28 per cent of the original capacity. Tests recently conducted under the general supervision of Professor John W. Langley, of the Case School of Applied Science, show that the battery carried through a uniform rate of discharge of 1 ampere per pound until the carriage had run the equivalent of 3060 miles. This test shows the capacity of the battery for the last 10 discharges to be 10 per cent (83.35 : 91.8) in excess of the first 10 discharges. The report indicates that tests up to this point had failed to reveal any indication that the battery had started to fall off in capacity. The 44th discharge of this battery, taking it at 1 ampere per pound of complete working cell, gives a mean potential difference throughout the curve, of over 2 volts, namely 2.014.

THE INTERNATIONAL STORAGE BATTERY.

The Clare cell, made by the International Storage Battery Company, is claimed to embody novel features of mechanical construction, that contribute to durability, efficiency, capacity for rapid working, and a relatively large output of energy per pound of maerial. Active material for these cells in the form of lead oxides is prepared before it is mounted on the supporting plates. These plates are made of porous earthenware, free from impurities that would render

FIG. 5.—BATTERY OF CLARE CELLS.

it a conductor. One side of each plate is divided into 100 small cells by narrow ribs that intersect at right angles. Into these cells the plastic active material is pressed.

The other side of each plate is provided with parallel ribs in one direction only, so that when these ribs on two plates are placed in contact the edges of the ribs touch, and there are parallel passages between them. Each plate is also provided with a heavy rib on one or two of its edges, and these heavy ribs extend further from

the plate than do the smaller ribs that enclose the cells for active material. After the active material is forced into its cells, two plates containing it are brought together so that the cells of active material face each other.

The heavy ribs at the edges of the plates hold them a short distance apart over that part of the surfaces where the active material is located. An acid-proof cement is applied to join the heavy ribs at the edges, and a receptacle containing the active material is thus formed by the two plates. Into the long, narrow opening of this

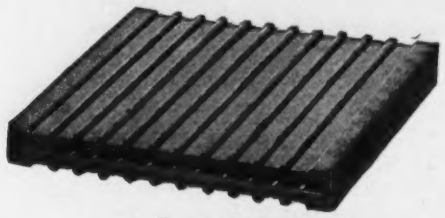


FIG. 6.—CLARE PLATE.

receptacle a sheet of pure, rolled lead is forced so as to come into intimate contact with all of the cells of active material. At one side a strip projects from this lead sheet and serves to connect it with a similar sheet between two other plates. The pair of earthenware plates with active material pressed into their cells, joined at their edges to form a receptacle, and the sheet of lead, form a single positive or negative element of the battery. The corresponding negative or positive element is made in exactly the same way.

The sheet of lead, about 1-32 inch in thickness, serves merely as a conductor of the current, and the earthenware receptacle supports both the active material and the conducting sheet. Two of the elements described go to make up the smallest size of battery. For batteries of larger size the receptacle for each element is made up of four or more of the same earthenware plates. All joints between the earthenware plates are made with the acid-proof cement, so that each receptacle, however large, is a rigid structure, though made up of a considerable number of parts.

Particular attention is called to the earthenware receptacle, because on its structure and on the method of supporting the active material, the novelty of the Clare battery depends. In this battery the conducting sheet of lead does not support the active material, but is itself supported by the receptacle. As the lead conductor is not required to act as a support, it can be, and is, relatively very light in weight. The earthenware receptacle is also much lighter than a supporting plate of lead would be for the same stiffness. The earthen-

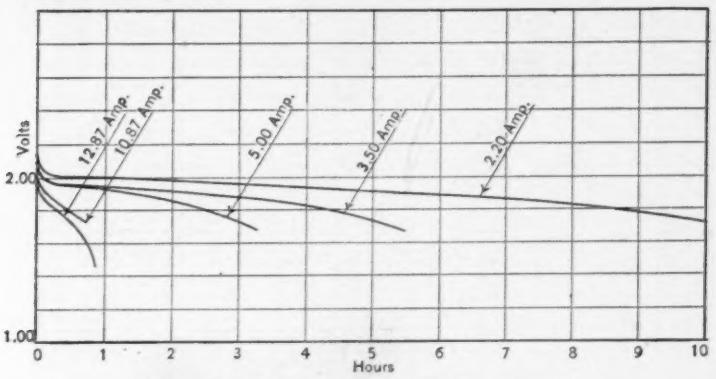


FIG. 7.—DISCHARGE CURVES, CLARE BATTERY.

ware receptacles with their active material and lead conductors are immersed in an acid electrolyte of the usual quality, and the solution passes freely through the porous sides of the receptacle to the active material. As the sides of the receptacles are very thin, being hardly more than 1-16 inch in thickness, and as the electrolyte flows freely through the grooves formed by the ribs on the outer sides of adjacent elements, the internal resistance of these batteries is very low. Active material cannot fall out of its cells in the earthenware plates, because the opening in the receptacle is only large enough to admit the conducting sheet of lead between the two surfaces where the conducting material is located. Experience has shown that the receptacles are sufficiently elastic to allow for all expansion of the active material without injury.

Several tests of these batteries have been made by independent engineers, and the result of one of these is illustrated in the curve here presented. This test was made on a battery rated at 20 ampere-hours. At the end of a 10-hour continuous discharge at the rate of 2.20 amperes, having yielded 22 ampere-hours, the terminal e. m. f. of the battery had fallen to 1.72 volts. During a continuous discharge of 3.5 hours at 5 amperes, yielding 17.5 ampere-hours, the battery dropped to 1.66 volts.

Another battery in a hard-rubber case had a total weight of 16 lbs. This battery during a continuous discharge of 12 amperes for eight hours fell from a terminal pressure of 2.1 to 1.9 volts. The ampere-hours delivered during this test were 96, and the watt-hours 192, so that the watt-hours per pound of complete battery were 12. Heavy overloads are said to have no bad effect on this battery, so far as the life of the elements is concerned.

A group of these cells that is said to have been in hard and constant use during two years, show no breaking or buckling of the earthenware receptacles or falling out of the active material.

THE PERRET BATTERY.

The Perfect storage battery is built on the unit system, the unit being a rectangular rod of pure metallic lead electrically formed in

FIG. 8.—PERRET UNIT.

a bath of pure dilute sulphuric acid. No other oxidizing agent is employed, and there is, therefore, no possibility of trouble from imperfect elimination of the compounds of nitrogen, chlorides, etc.

Each unit has a certain, definite capacity, and any number may be burned together to form a cell of the required size. Before formation

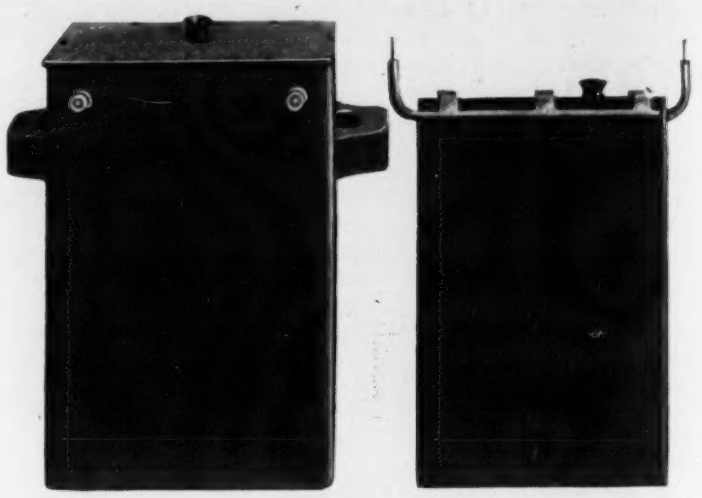


FIG. 9.—PERRET CELLS.

the units are all exactly alike, there being no difference between those intended for positive or negative elements. The rods intended for the positive elements of one cell are burned together with those of the negative elements of the next cell, and all the rods are suspended by their own lugs from the tops of the cells and do not touch anything at their lower extremities. Each unit is free to expand, contract or

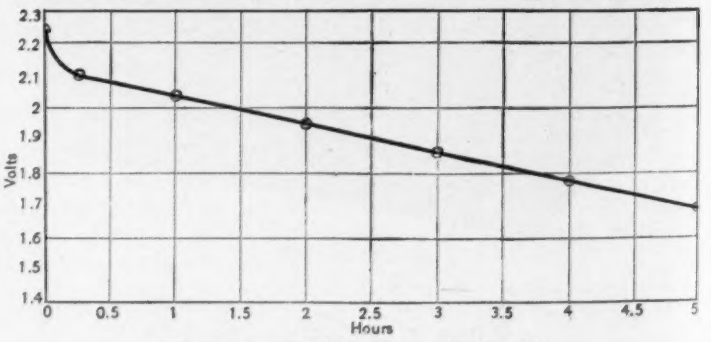


FIG. 10.—DISCHARGE CURVE, PERRET CELL.

twist without warping the element as a whole, which differs materially from the ordinary plate.

The discharge curve (Fig. 10) refers to a Perret cell weighing 7½ lbs. This shows a capacity of 1.33 amperes, or 2,527 watts, per pound

at the 5-hour rate, which is equivalent to 6.65 ampere-hours, or 12.635 watt-hours, per pound of complete cell. The cell may be discharbed in three hours or less, and charged in the same length of time without injury.

These cells are made in two sizes at present, though the makers intend putting other sizes on the market within the next few months. Type A is 10 by 6½ by 1⅛ inches, weight 7½ lbs., capacity as above. Type B is 10 by 13 by 1 3-16 inches, weight 15 lbs., capacity 100 ampere-hours at 5-hour discharge rate.

THE GOULD BATTERY.

The plates of the Gould battery are made from pure rolled lead. These plates have their surface increased by a spinning process. This spinning is accomplished by clamping the plate in a special machine whereby it is given a reciprocating motion between rapidly revolving arbors carrying a series of disks which are forced into the plate, displacing the lead into a series of alternating ribs and grooves. The active surface of the plate is thus increased to 17 times its area as a smooth plate. This pressing and displacing increases the density and homogeneity of the plate, and makes it more durable. The spinning process leaves the ribs firmly connected to the supports so that each rib is independent and has an independent contact with the supports, and it is not necessary to depend on a center webb for conductivity. The plates are thus in a condition to allow of the expansion and contraction, due to charge and discharge, taking place without loss of active material or damage to the grid. The plates are placed in a bath and current passed through them, whereby active material is formed from the material of the plates themselves. After forming, the plates are cleaned, washed, and all traces of the forming solution removed, the plates are then assembled into elements consisting of the various numbers of plates, according to the capacities required.

FIG. 11.—GOULD CELL.

The principle followed by the Gould Storage Battery Company is to increase the surface exposure as well as to increase the contact area of the active material with the grid, it having been demonstrated by their tests that by reducing the rate of charge and discharge per square inch of active surface, the life of the battery is increased, as well as its ability to stand high rates of charge and discharge.

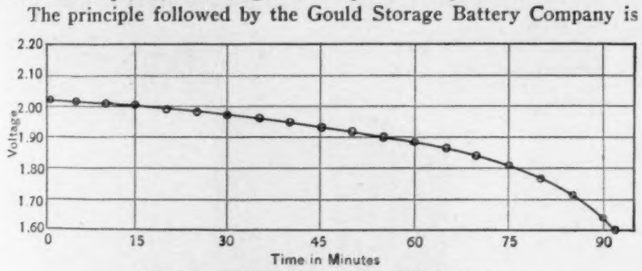


FIG. 12.—DISCHARGE CURVE, GOULD CELL.

The plates are therefore made as light as mechanical considerations will permit, and the greatest possible amount of active surface is obtained by the spinning process before mentioned. The actual active surface is 450 square inches per pound of plate, which gives 250 square inches per ampere at the 8-hour discharge rate. As the active oxides form in a thin adherent layer over the surface, the voltage at rapid discharge rates is somewhat higher than usual in lead cells. The thinness and porosity of the active material permits the escape of evolved gases without dislodging the oxides.

The separators consist of the usual ribbed and perforated rubber sheet, and the jars are of the same material. These jars have, raised on the bottom, two heavy ribs upon which the plates rest. This leaves a proper space below the plates for circulation of electrolyte, and the accumulation of sediment. A hard rubber cover fitting into the top of the jar and resting on the top of the cross bars prevents splashing of the electrolyte. The connectors are of the usual flat top variety.

The foregoing table gives weights, dimensions and capacities of the Gould automobile batteries, Type EV, dimensions of plate, 5⅞ inches by 9 inches.

This shows that at the 3-hour rate, 1.10 amperes, or 2.09 watts, are continuously available, which is 3.30 ampere-hours, or 6.27 watt-hours, per pound, gross weight of battery.

THE CHLORIDE ACCUMULATOR.

The general characteristics of this battery are well-known. The positive plate is termed "Manchester Plate" by its makers, and consists of a grid cast of lead with round holes about 13-16 inch in diameter and 15-16 inch between centers.

FIG. 13.—CHLORIDE ACCUMULATOR.

These holes taper to a smaller diameter from the outside surface to the middle of the plate, making in effect holes which are counter sunk, from both faces of the plate. The active material consists of pure lead which is taken in the form of ribbon, the width of which is equal to the thickness of the plate, and passed between two rollers. The periphery of the lower roller is smooth, while the upper one is toothed, the teeth cut into the lead ribbon making a ridged surface. The ribbon is then cut into suitable lengths and rolled into spirals, the outside diameter of which is the same as the diameter of the hole in the grid measured at its smallest diameter. These spirals are pushed into the holes and tightened by expanding, when the plate is "formed" by charging.

A lead ribbon which has been ridged on one surface forms, when rolled into a spiral, a pellet of active material which is very porous and allows free circulation of the electrolyte through the plate.

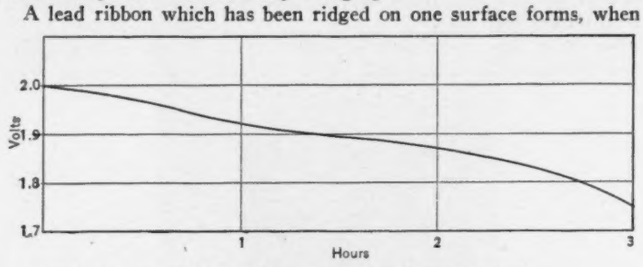


FIG. 14.—DISCHARGE CURVE, CHLORIDE ACCUMULATOR.

The negative plates are the regular "chloride" type, made by casting the grid around the pellets of active material, these pellets being placed in the moulds. This grid is of lead alloyed with a small amount of antimony and cast under heavy pressure, to insure good electrical contact between the pellets and the grid, and also to make the latter take firm hold of the pellets and obviate any danger of their dropping out.

The pellets are made of finely powdered lead, which is dissolved in nitric acid. The addition of hydrochloric acid to the solution pre-

Element number	905A	907A	909A	911A	913A	915A	905C	907C	909C	911C	913C	915C
Number of plates	5	7	9	11	13	15	5	7	9	11	13	15
Normal charging rate	18	27	36	45	54	63	22½	33¾	45	56¼	65	78¾
Discharge in amperes for 4 hours	17	25	33	41	49	57½	22½	33¾	45	56¼	65	78¾
Capacity in ampere hours at 3 hours discharge	60	90	120	150	180	210	81	121½	162	202½	243	283½
Capacity in ampere hours at 4 hours discharge	68	100	132	164	196	230	90	135	180	225	270	315
Weight of element in lbs.	15¾	22¾	29¾	36¼	43	48¾	13.8	20.5	27	33.8	40.5	47.5
Outside dimensions of rubber jar in inches. Width	2½	3¼	4¼	5¼	6¼	7¼	2½	3¼	4¼	5¼	6¼	7¼
Outside dimensions of rubber jar in inches. Length	6¼	6¼	6¼	6¼	6¼	6¼	6¼	6¼	6¼	6¼	6¼	6¼
Outside dimensions of rubber jar in inches. Height	11½	11½	11½	11½	11½	11½	11½	11½	11½	11½	11½	11½
Height of cell over all, in inches	12	12	12	12	12	12	12	12	12	12	12	12
Weight of acid in pounds	3¼	4½	5¼	6½	7¾	8¾	4	5.3	7.1	8.8	10.5	12.2
Weight of cell complete in pounds	20¼	28½	37	44¾	51½	59½	19	27	35.5	44.1	53.3	62.2

cipitates the lead in form of lead chloride. The precipitate after being washed is melted with zinc chloride and the fused mixture poured into moulds the form of the pellets. These are approximately ¾ of an inch square, and the same thickness as the grid, namely, ¼ inch.

The finished plates are placed between zinc plates and immersed in a zinc chloride solution. On short circuiting the plates, the actions set up are such as to remove the chloride, leaving the pellet in the form of pure lead in a very porous state. The types manufactured are denominated M, FV, MV, OV, PV, QV, RV, TV, UV and SV. The various types of plates and cells, their sizes, capacities, etc., are as given in the following table:

ELEMENTS OF TYPE MV.

Number of plates.		5	7	9	11	13	15	7 inverted.
Discharge in amperes for 3 hours		18	27½	36½	45½	55	64	30½
Size of plates.	Length.	5⅞	5⅞	5⅞	5⅞	5⅞	5⅞	9¼
	Height.	8½	8½	8½	8½	8½	8½	5 13-16
Outside measurements of rubber jar in inches.	Width.	2 7-16	3¼	4 7-32	5 3-16	6 7-32	7 3-16	3¼
	Height.	10⅜	11½	11½	11½	11 9-16	11 9-16	8 3-16
	Length.	6 3-16	6 3-16	6 3-16	6 3-16	6¼	6¼	9⅞

To height of jar add ¾ inch for standard type of connection.

Weight in Pounds.								
	Elements.	16	22¾	29½	36½	43¼	50	24¾
	Electrolyte.	2¾	4	5	6½	7¾	8¾	4¾
	Complete cell.	19¾	28	36	44½	53¼	61½	31

It will be noted that the jars of 7 TV, 7 UV and 7 RV are higher than those of the other types. This renders sealing unnecessary, as the electrolyte does not fill the jar, there being about 4 inches between the surface of the electrolyte and the top of the jar, which is ample to prevent the liquid from slopping over. These can only be used in automobiles, which have deep bodies giving sufficient head room for the high jars.

MISCELLANEOUS TYPES.

Number of Plates		7 QV	7 PV	7 TV	7 RV	7 SV	9 OV	5 M	5 FV	7 UV
Type of plates										
Discharge in amperes for 3 hours		13	22½	36	22½	17	43	31½	24	27½
Size of plates	Length	3 1-16	4⅞	5½	4½	3⅞	6⅜	10½	5⅜	11¼
	Height	8¾	8½	12	9¼	8 11-16	8½	7⅜	10⅜	4½
Outside measurements of rubber jar in inches.	Width	3¼	3¼	3½	3½	3¼	4¼	2 3-16	2 13-16	3½
	Length	3 7-16	5 5-16	5¾	4 13-16	4 3-16	7¼	11 7-32	6 3-16	4 13-16
	Height	11½	11½	16¾	13 3-16	11½	11½	11 5-32	14¾	15 3-16

To height of jar add ¾ inch for standard type of connection.

Weight in pounds										
	Elements	12½	19¼	30¾	19¼	15	33	26	21¼	23
	Electrolyte	1¾	3¼	6	4¼	2¼	6½	4¾	5	4½
	Complete cell	15¾	23½	39¼	25¾	18¼	41½	32½	27¼	29¼

The other types require to be sealed, which is done with a cover made of hard sheet rubber fitting tightly in the cell. It rests on supports below the top of the cell, and may be made water-tight at the edges by a black composition put in in the form of fillet, one side of which rests on the cover and the other rests against the inner walls of the cell. A small hole is made in the middle of the cover for ventilation and escape of gas.

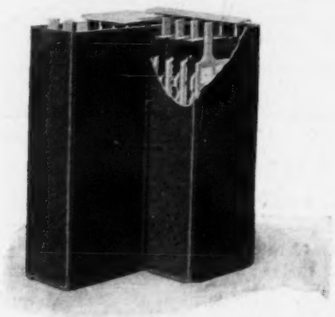


FIG. 15.—EXIDE CELL.

The connectors are generally U-shaped, the two ends being fastened to two sets of plates, and the bend passing over the edge of the jars that abut against each other. The elements in high jars are connected by "flap top" connectors.

Several types of separators are used, one being made of corrugated hard rubber, pierced with a number of small holes through which the electrolyte can circulate. In order to secure lightness, the jars are made thin. They are sufficiently strong for rough usage when put together in a tray, so that the contiguous cells or sides of trays afford support. They are, however, not strong enough to be used without trays or separated from adjacent jars. The table shows

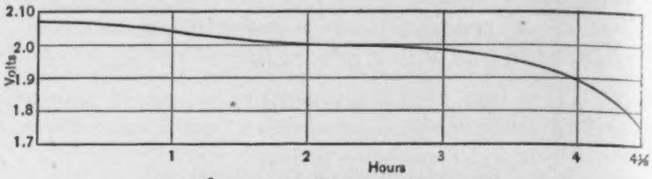


FIG. 16.—DISCHARGE CURVE, EXIDE CELL.

that these cells give an average of .98 ampere or 1.86 watts per pound gross weight at the 3-hour discharge rate.

A new automobile battery which the Electric Storage Battery Company has brought out, is called the "Exide Accumulator" (Fig. 15). No information as to principles and construction is available. It is, however, a form of pasted plate and much lighter than the "Chloride" accumulator, as will be noted from the accompanying table:

TYPE PV "EXIDE" BATTERY.

Number of plates		5	7	9	11
Discharge in amperes for 4 hours		12	18	24	30
Size of plates	Length	4 13-16	4 13-16	4 13-16	4 13-16
	Height	8⅝	8⅝	8⅝	8⅝
Outside measurement of rubber jar, in inches	Width	1 13-16	2 9-16	3¾	4¼
	Length	5 5-16	5 5-16	5 5-16	5 5-16
	Height	11½	11½	11½	11½
Weight in pounds	Elements	9¼	13¼	17¼	21½
	Electrolyte	1½	2¼	3	4½
	Complete cell	11½	17½	21½	27½

This shows that the capacity at the 3-hour rate of discharge is 1.33 amperes, 2.53 watts, 3.99 ampere-hours, and 7.59 watt-hours per pound of cell.

THE WILLARD BATTERY.

This battery is made up of plates of the Planté type, which are sheets of pure lead, ribbed or grooved. The Willard plate is grooved across the width of the plate, the ribs not being perpendicular to its surface, but making an angle with it; that is, the cut is in a downward direction from the surface to the center of the plate, which viewed from the edge presents a "herring bone" cross section, the ribs sloping upward. These ribs are very thin and flexible, and their surfaces increase the active surface of the smooth plate to about 16 times its original area.

On formation of the lead oxides on a positive plate, the active lead is expanded, and in case of rapid charge this expansion may distort the plate and cause buckling, or the pressing out of the active oxides. The Willard cell, so the makers claim, is not subject to any deterioration or buckling, as the active oxides are formed between the ribs of the plate and their expansion only opens out the ribs, separating them a slight amount from each other. The manner of "forming" these plates is not stated, but an examination indicates that the process is chemically alkaline.

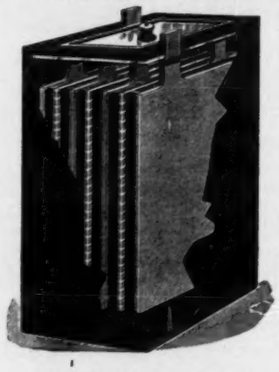


FIG. 17.—WILLARD CELL.

The construction gives a plate without any joint whatever between the active and the conducting lead of each plate, as each rib is an integral portion of the plate. This results in a low internal resistance. The makers state that by charging 20 minutes at double the normal charge rate, then at one and one-half times for 10 minutes

and one-fourth capacity for 20 minutes, the battery can be charged within 50 minutes without any injury to or deterioration of same. The capacity referred to is on a basis of 1-hour discharge.

The form of plate used permits high charging rates when the cell is empty. It is also stated that this battery can be made to discharge completely in 30 minutes without damage, though a higher rate is not

45-MINUTE CHARGING TABLE, WILLARD BATTERY.

Cell No.	20 min.	5 min.	5 min.	10 min.	5 min.
1001	72 amps.	52 amps.	36 amps.	16 amps.	5 amps.
1005	96 "	68 "	48 "	20 "	7 "
1105	118 "	84 "	59 "	26 "	9 "
1007	140 "	100 "	70 "	30 "	10 "
1107	178 "	128 "	90 "	38 "	12 "
1109	238 "	170 "	119 "	51 "	17 "
1111	300 "	214 "	150 "	64 "	21 "
1113	356 "	254 "	178 "	76 "	26 "
1115	420 "	300 "	210 "	90 "	30 "

advisable. The separators are made of hard rubber, fashioned in the form of a sheath. They are ribbed to secure strength and perforated to allow free circulation of electrolyte.

The makers do not claim extreme lightness for their batteries, as

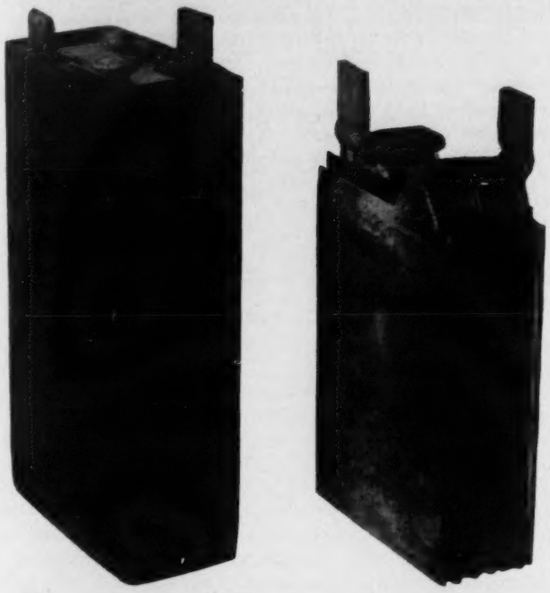


FIG. 18.—WILLARD CELL AND PLATES.

their idea is that plenty of lead is required for durability, and that light batteries are subject to more rapid deterioration than heavy ones. Their automobile battery they claim is a compromise between the weight necessary for durability and lightness required to prevent vehicles from being too heavy and clumsy. In this compromise the

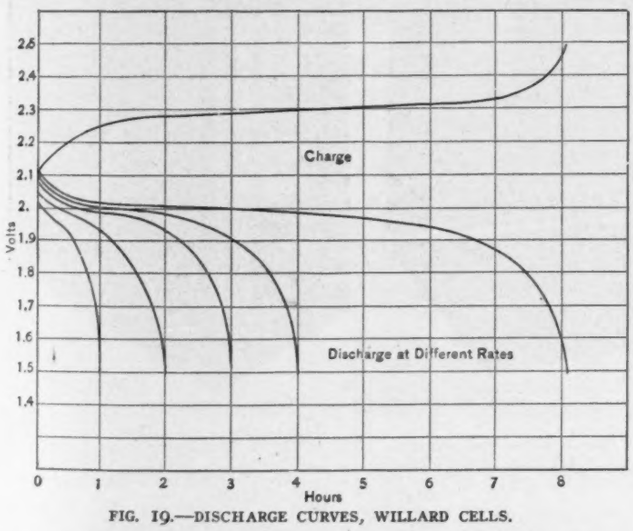


FIG. 19.—DISCHARGE CURVES, WILLARD CELLS.

makers believe that they have reduced the weight of the plates to the lowest amount compatible with long life under the arduous service to which automobile batteries are subjected.

A series of curves is shown in Fig. 19, which gives, graphically, the relation between voltage and time of discharge of the Willard cell at varying rates of discharge. The uppermost curve shows this relation on charge at the 8-hour rate.

The makers of the Willard battery manufacture two types for automobile service. One is designated the "Standard," and the other the "Willard Special." The accompanying tables give the data of the two types:

WILLARD STANDARD.

Cell Number.	Wt. in Lbs.	Outside Dimensions in Inches.			Ampere-four capacity when discharged in 3, 4, 5 or 6 hours.			
		Wide.	Long.	High.	3 Hrs.	4 Hrs.	5 Hrs.	6 Hrs.
1001	13	5 9-16	2⅜	8¼	34	38	40	42
1005	16	5 9-16	2⅜	9⅜	45	50	53	55
1105	19	6⅜	2⅜	10⅜	56	63	67	70
1007	22	5 9-16	3¾	9⅜	66	73	78	81
1107	28	6⅜	3¾	10⅜	84	93	99	103
1109	35	6⅜	4⅞	10⅜	112	124	132	137
1111	43	6⅜	6	10⅜	140	155	165	171
1113	50	6⅜	7⅛	10⅜	168	186	198	206
1115	58	6⅜	8¼	10⅜	196	217	231	240

WILLARD SPECIAL.

1405	18	5 9-16	3¼	10⅜	48	53	56	59
1407	25	5 9-16	4 11-16	10⅜	72	80	85	89
1409	31	5 9-16	6⅛	10⅜	96	106	112	117
1411	37	5 9-16	7 9-16	10⅜	120	132	140	147
1413	44	5 9-16	9	10⅜	144	158	167	175
1415	50	5 9-16	10 7-16	10⅜	168	185	196	205
1505	21	6⅜	3¼	11⅜	62	68	72	75
1507	31	6⅜	4 11-16	11⅜	93	103	109	114
1509	39	6⅜	6⅛	11⅜	124	137	145	152
1511	47	6⅜	7 9-16	11⅜	155	170	180	189
1513	55	6⅜	9	11⅜	186	206	218	229
1515	63	6⅜	10 7-16	11⅜	217	240	254	266

From the foregoing, it will be seen that the continuous output of the "Standard" batteries averages .96 ampere, or 1.82 watts, per pound gross weight, on a basis of 3-hour discharge rate, which is equivalent to a total output of 2.88 ampere-hours, or 5.47 watt-hours. The "Special" gives 1.01 amperes, or 1.92 watts, continuously for three hours, being a total of 3.03 ampere-hours, or 5.75 watt-hours, per pound gross weight.

PORTER BATTERY.

The construction of the Porter cell differs materially from other types of pasted or chemically formed lead batteries. The plate or grid itself for automobile work is 5 by 7 inches and ⅛ inch thick. It is composed of an alloy or compound which the manufacturers state gives greater conductivity, greater resiliency and consequently greater working capacity than the ordinary pure lead plate, and also resists the action of the sulphuric acid in the electrolyte that upon

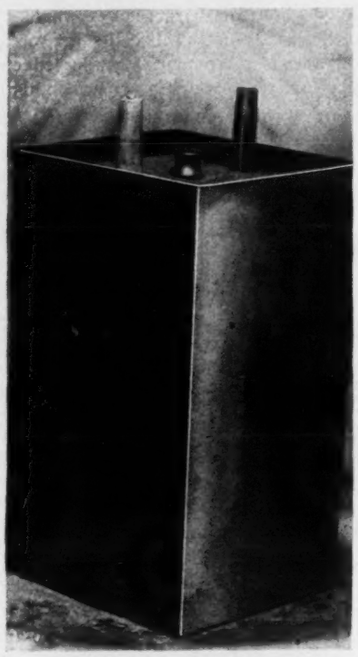


FIG. 20.—PORTER CELL.

lead produces sulphate of lead or the white precipitant which causes so much of the trouble in the pure lead types. The active material is securely held in the grid so that its greatest width is in the center of the plate and the smallest surface is exposed. This not only acts

as a wedge, but also allows the material to do the greatest amount of work with a minimum of wear, and greatly increases the proportion of capacity with the surface of active material exposed, at the ratio of about 3½ to 1. The active material itself is treated before being

Cell No.	Weight.	Outside Dimensions.			Ampere-Hour Capacity.		
		Wide.	Long.	High.	3 Hours.	4 Hours.	5 Hours.
5	8½	5¼	1⅝	10	32	38	42
7	11	5¼	2⅛	10	48	57	61
9	13½	5¼	2⅝	10	64	76	84
11	18	5¼	3⅛	10	80	95	106
13	21	5¼	3⅝	10	96	114	124
15	25	5¼	4⅛	10	112	133	146
17	28	5¼	4⅝	10	128	152	167
19	31	5¼	5⅛	10	144	171	188
33	50	5¼	⅞	10	256	304	334

"formed," and the relative distances, while in the forming process, are increased and decreased proportionately, so that the interior is also formed, and not alone the outer surface, as is ordinarily the case.

From the preceding table issued by the manufacturers, it will be noted that on a high discharge, such as is required in automobile work, great capacity per pound weight is shown.

All the parts of cells are standard and interchangeable, which is very desirable. In the method of working up the batteries, the cells

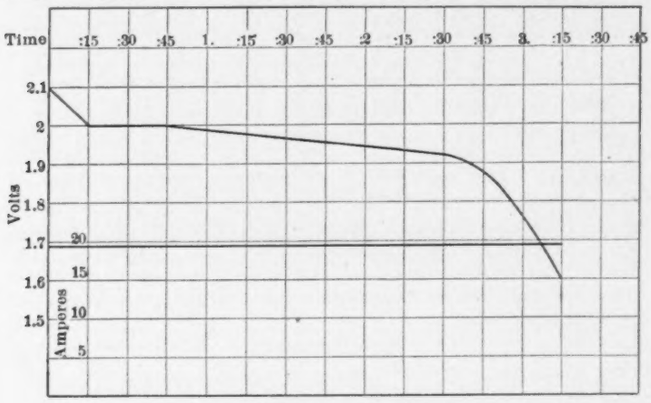
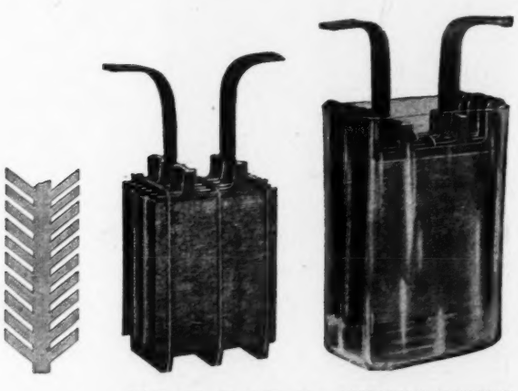


FIG. 21.—DISCHARGE CURVE, PORTER CELL.

are all formed of equal capacity and all work within .05 volts of each other on an equal discharge, so that the danger from reversed cells on a low discharge is extremely small. The curve of Fig. 21 refers to a 12-lb. cell discharging at a little over a 3-hour rate.

The efficiency on a constant-current, constant-potential circuit, on a 4¾-hour charge, 3½-hour discharge, is very high, standing a little above 88 per cent, the charge on a 13-lb. cell being 76 amperes, and the discharge 67. On a constant potential graduated current the percentage of efficiency in ampere-hours is very much higher. The 25-lb. cell being started at 50 amperes and finished at 8 amperes, takes a total of 260 ampere-hours, and discharging at a 6-ampere rate, 247 ampere-hours, or a little over 95 per cent. The average voltage on this discharge is 1.9 volts per cell, so that the watt capacity of each cell would be 494, and the weight per horse-power-hour would be a little less than 40 lbs. On a high discharge rate, as required in automobile work, the capacity is necessarily reduced and the weight is increased to between 50 and 60 lbs. per horse-power-hour.



FIGS. 22, 23 AND 24.—AMERICAN BATTERY.

This battery now holds the world's record for long distance runs in automobiles, having done in Chicago on 600 lbs. weight, 187½ miles on a single charge in an electric Stanhope. As this was a very light vehicle, the manufacturers do not consider it as a practical demonstration for other vehicles. On 500 lbs. of battery they have run a Woods road wagon at a speed of 10 miles per hour 80 miles on a single charge. In a Buffalo Electric Carriage Company's Stanhope, over country and hilly roads, the wagon has run as high as 69 miles on a single charge, equipped with a 40-cell set, No. 11, Type A. Fig. 20 shows a No. 21, Type A cell, weighing 35 lbs., and having a capacity of 250 ampere-hours. It was with this type of cell that a run of 151 miles was made at Cleveland, Ohio.

THE AMERICAN BATTERY.

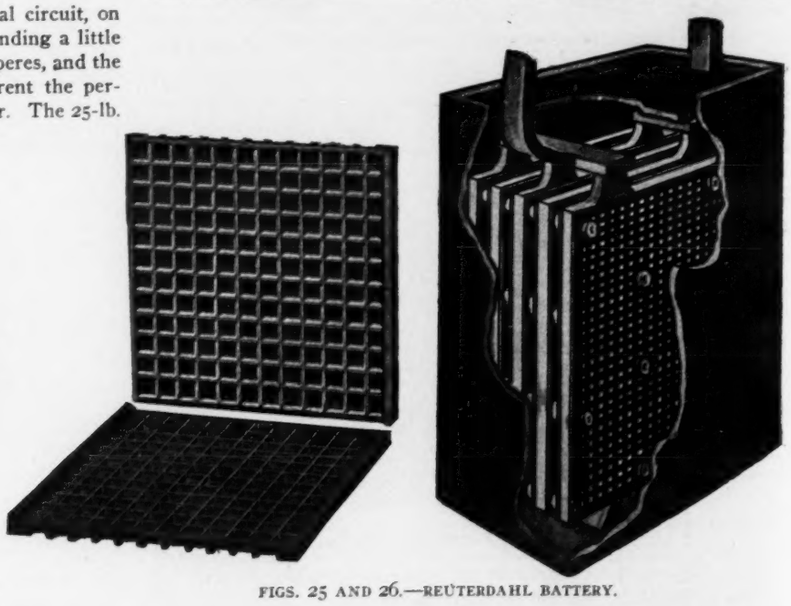
This battery is made up of elements which are formed by grooving pure sheet lead, leaving a number of thin projecting ribs. The active material is electro-chemically formed, as is usual in such batteries. The ribs are turned upwards.

The plates are supported by insulators, which lift them off the bottom of the jar and also serve to separate the plates. The elements are in this way suspended, and there is left a clear space in the bottom for the circulation of electrolyte and the deposition of sediment without danger of short circuiting.

Interposed between the insulators and positive plates are thin perforated sheets of hard rubber which are put in as an additional protection against contact of plates and consequent short circuits.

The separation between the positive and negative plates is somewhat greater than is usual in lead batteries, being a full quarter of an inch. This is to allow free circulation of electrolyte. This increases the internal resistance but very slightly, and the size of the cell for a given capacity. Following is a table of dimensions, weights and capacities of the American batteries:

Type.	3-Hour Rate.	5-Hour Rate.	DIMENSIONS.			Weight. Pounds.
			Length. Inches.	Width. Inches.	Height. Inches.	
M. ½	8	5½	6⅝	1⅞	8⅛	10
M. 1	10	7	6⅝	1⅞	9⅝	13
A. 1	13	9	6⅝	1⅞	11⅝	15
M. 2	18	12	6⅝	3⅛	9⅝	21
A. 2	24	16	6⅝	3⅛	11⅝	26
M. 3	27	18	6⅝	4½	9⅝	30
A. 3	36	24	6⅝	4½	11⅝	36
M. 4	36	24	6⅝	5⅞	9⅝	39
M. 5	45	30	6⅝	7¼	9⅝	48
A. 4	48	32	6⅝	5⅞	11⅝	48
A. 5	60	40	6⅝	7¼	11⅝	61
A. 6	72	48	6⅝	8⅝	11⅝	72



FIGS. 25 AND 26.—REUTERDAHL BATTERY.

This battery holds the world's record for long distance runs in automobiles, having done in Chicago on 600 lbs. weight, 187½ miles on a single charge in an electric Stanhope. As this was a very light vehicle, the manufacturers do not consider it as a practical demonstration for other vehicles. On 500 lbs. of battery they have run a Woods road wagon at a speed of 10 miles per hour 80 miles on a single charge. In a Buffalo Electric Carriage Company's Stanhope, over country and hilly roads, the wagon has run as high as 69 miles on a single charge, equipped with a 40-cell set, No. 11, Type A. Fig. 20 shows a No. 21, Type A cell, weighing 35 lbs., and having a capacity of 250 ampere-hours. It was with this type of cell that a run of 151 miles was made at Cleveland, Ohio.

THE REUTERDAHL BATTERY.

The elements of this battery consist of grids or plates of lead antimoniated so as not to be acted on by the electrolyte, imbedded in and surrounded by a mass of active material. The plate or grid serves only as a conductor. It is rendered dense and of low resistance by casting under pressure.

These show .96 ampere, 1.824 watts, 2.88 ampere-hours and 5.47 watt-hours per pound weight of cell at 3-hour discharge rate.

The details as to constituents of active material are not given. The negative material is spongy lead and the positive lead peroxide. The plates are formed partly by Planté and partly by Faure processes.

The active material after being pressed into a compact mass surrounding the grid, is enveloped by a sheath that retains the material in its proper position, and does not allow it to fall away. This sheath consists of a framework of hard rubber or chemically prepared wood having a sheet of perforated hard rubber on each side. These perforations are 1-16 inch in diameter and spaced ⅛ inch between centers.

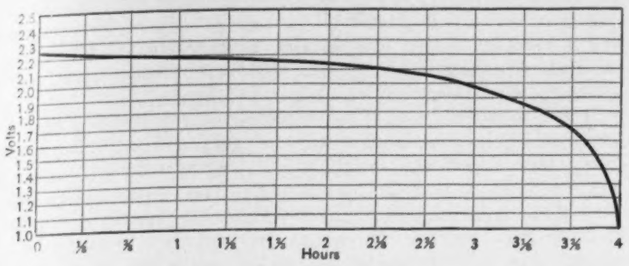


FIG. 27.—DISCHARGE CURVE, REUTERDAHL CELL.

The sheets of hard rubber are held against the frame by hard rubber bolts passing through holes in the sheets and framework. These bolts are of such length and so arranged that they serve to hold the sheets against the frame, and to separate the composite plates from each other. Besides the bolts passing through the frame there are bolts passing through the plate itself.

The purpose of these bolts is to hold the sheets of rubber at a fixed distance apart and thus insure the retention of the active material against the grid.

The interior bolts are so staggered that a bolt from one element does not abut against a bolt in the adjoining element but comes against the sheets of rubber surrounding that element, so that with five bolts through each there are 10 points of separation. The central bolts thus serve the double purpose of retaining the sheets in proper and definite relation to each other, as well as separating adjoining elements. The sheet rubber allows for expansion of the active material, as it combines flexibility and rigidity.

The chief difference between this and other lead storage batteries consists in the retaining case and grid, which do not enter into the electrolytic action at all. The life of the element therefore does not depend on the support, but on the active material only. The containing jar is of hard rubber, with ribs on the bottom on which the elements rest. All conductors are of antimonious lead cast under pressure. The capacity of the Reuterdahl 22-lb. cell at a 3-hour discharge rate is given as follows: Amperes per pound, 1.5; watts per pound, 2.85; ampere-hours per pound, 4.5; watt-hours per pound, 8.55.

THE OSBURN BATTERY.

This battery belongs to the pasted plate class, and at present is made exclusively for automobile work. The inventor, however, has attacked the problem of low cost of battery per mile of vehicle travel in an original and unusual way.

The manufacturers contend that durability is only one of the factors which make up the cost of maintenance and operation of an electric vehicle, and that it resolves itself into the question of total cost of operation per mile. In automobile work the questions of weight and cost of carrying this weight must be considered. Lead being the principal ingredient in a storage battery, and each pound storing a given amount of energy, the life is shorter with a light weight battery, but the battery also costs less. Therefore, it does not appear economical to pay for and transport for an entire year a sufficient amount of lead for the succeeding year.

Mr. Osburn, therefore, has set to work to produce a battery in which the elements will last from 6 to 12 months, and be light enough to reduce the total weight carried to a minimum, and the cost low enough to enable a complete replacement once or twice a year, and still keep the cost of battery per mile within a reasonable limit.

This would certainly result in a satisfactory battery for the purchaser, as the initial investment is low, the maintenance not more than is usual with automobile batteries, and he would have a new battery at the beginning of the second year instead of one partly run down. With these ideas in view the Osburn battery was developed.

In the construction of the grid lies the principal difference between it and the other varieties of pasted cells. These grids are made from pure lead of special manufacture, and are stamped in presses into a network of metal adapted to hold the active element, and at the same time to furnish a connection to all parts of it.

The plate is formed from a thin sheet of rolled lead. Rows of small square holes are punched into the sheet, diagonal cuts are then made from the corners of the holes, and the flap thus formed is turned at right angles to the surface of the plate, forming a series of pockets for containing the active material.

The thickness of the completed plate is equal to the sum of the thickness of the lead and the pockets formed by the portions turned at right angles. The opposite faces of the upturned portions form the side walls of adjacent pockets, while the greater portion of the edges are brought into contact with the active material, the only portions of the plate thus not in contact being the side edges of the sections. This insures a maximum amount of surface to the active material, therefore resulting in a maximum rate of discharge for a given weight.

The active material consists of precipitated lead mixed with lead oxide and a small amount of some other chemical which the inventor does not at this time care to make public. The material is pasted into the grid and then subjected to pressure. The forming process is the same as that usual in pasted plates. It should be noticed that the applied material forms a continuous active surface, every part of the grid being covered. The grid is therefore protected from the action of the electrolyte, and disintegration avoided.

The negative plates are made much thinner and lighter than the positive, as it has been found that the negatives may have their weight and cross section decreased without altering the durability of

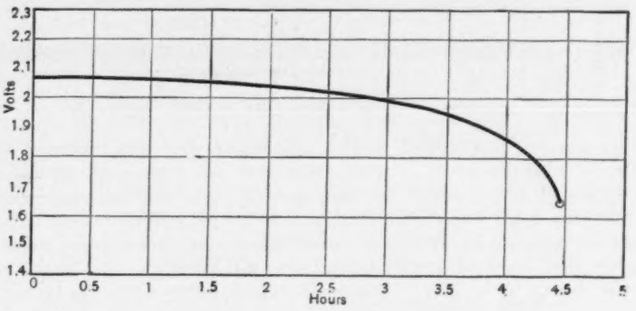


FIG. 28.—DISCHARGE CURVE, OSBURN BATTERY.

the battery, if the active surface be kept equal to that of the positives, exclusive, of course, of the outside surfaces of the first and last negative plates in each group, which are inactive.

The separators are also of unusual construction. They are made of thin, hard, sheet rubber 1-64 inch thick. Pairs of slits are made at proper intervals in the sheet and woven through these slits are round, hard rubber rods. These latter form vertical ribs that strengthen the thin sheets and give a proper distance of separation between the elements. The completed separator is ⅛ inch thick, which is also the distance between plates.

The separators extend downwards below the ends of the plates, and are held together by round, hard rubber rods, which pass through the lower ends of the separators at right angles to their surfaces, each rod passing through all the separators. The jars are the usual hard rubber variety, generally sealed, and vented by a small hole in the center of the cover.

The standard cell consists of nine negative and eight positive plates, each plate being 7½ inches by 2¾ inches. The size of the containing jar is 3¼ inches by 5¼ inches by 10¾ inches. The electrolyte is 1¼ inches deep over the top edges of the plates. The complete cell weighs 15 lbs. gross.

The following is the output per pound gross weight at the 3-hour discharge rate: Amperes, 1-75; watts, 3.5; ampere-hours, 5.25; watt-hours, 10.5. Fig. 28 shows a discharge curve of this battery at the 4-hour rate. It will be seen that the voltage holds up above 2 volts for 2¾ hours, thus keeping up the average voltage and wattage.

The inventor claims that a number of sets of these batteries have made over 2000 miles before any repairs were needed.

Tangential Traction Electric Railway System.

A CURIOUS system of electric traction has been proposed by MM. Dulait, Rosenfeld and Zelenay, of Charleroi, Belgium, in which there is a complete absence of a rotative motor on the car and of any electrical connection between the car and the line. The movement of the car is assumed to be obtained through the influence of a magnetic field traveling with the car.

As is well-known, in induction motors there is no electrical connection between the rotor and the stator; the current in the stator

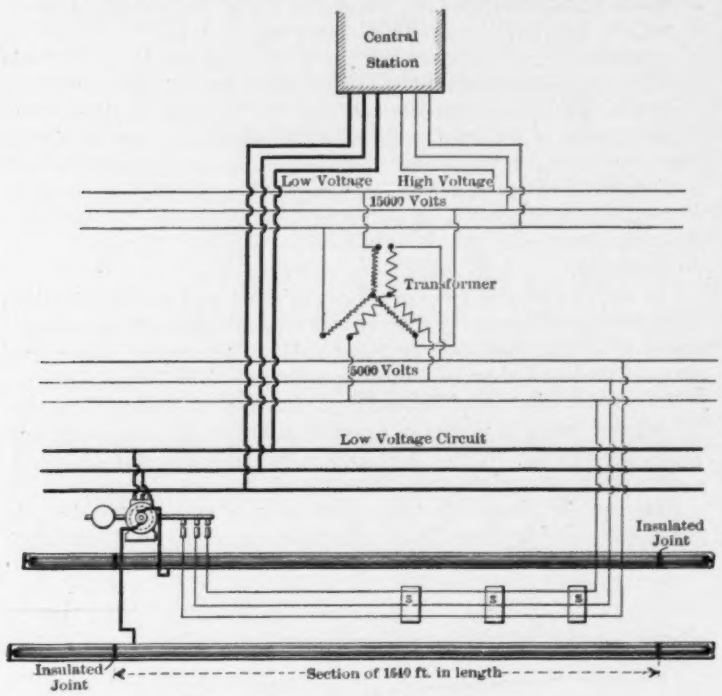


FIG. I.—DIAGRAM OF CONNECTIONS.

produces a rotary field, and this acting on the rotor causes it to travel with the field. If, now, we imagine the surface of the stator developed into a straight surface, and the rotor similarly developed and suspended above, the rotary movement will, the inventors state, be transformed into a movement of translation, and it is not necessary that the rotor should extend over the stator the full length of the latter. Now, taking the case of a car running on two rails, suppose the developed stator to be placed between the rails and that the developed rotor is suspended under a car and over the stator. The car will then be put in motion when polyphase currents flow in the stator. Under these conditions the magnetic field is no longer a rotary one but a field of translation.

As to the objections which may be presented to this system on the score of large air-gap, which in ordinary motors is sometimes less than 1-32 of an inch, it is granted that a small air-gap would be impracticable in the present system, but the inventors state that they have been enabled very largely to increase the air-gap and at the same time largely reduce the quantity of copper required. No information is given, however, as to how this end has been attained.

Another objection that may be urged against the system is that a large portion of the developed stator will require to be energized. The inventors state that they have met this difficulty by dividing the stator into sections each having its own feeders. The ideal length of the sections would be such that there would be never any current except in the section covered by the car. It is stated, however, that it has been found that sections 1600 ft. in length will give a very satisfactory efficiency. Cutting in and out of circuits is performed automatically by electrical means from the car itself.

It is also claimed that it has experimentally been found that the stator can be discontinuous and that in general it will suffice to lay down stators over only a fifth of the length of a road. Another point adduced is that the construction of the system can be made such that consumption of energy will be almost constant at all points of the line, whether the car is running on a lavel or on a grade. The only explanation offered for this is that the speed of a three-phase motor is varied by varying the number of poles.

This system is claimed to have a great advantage from the fact that it will permit of the direct employment of currents of the highest tension, since the exciting circuit, being in no place exposed, can give rise to no danger.

In a pamphlet by the inventors from which the above is translated, a table is given showing the relative cost of traction by the trolley system and the tangential system. In the case of a schedule speed of 62 miles per hour and a maximum speed of 75 miles, the efficiency of the last-mentioned system is put at 64 per cent, and that of the direct-current trolley system at 54 per cent. One of the accompanying illustrations show a track and car equipped with the system, and another gives a diagram of the connections.

Submarine Boat Launched.

The new submarine torpedo boat "Porpoise" was launched at 3.30 o'clock p. m. on Sept. 23 from the Crescent Shipyard, Elizabethport, N. J. Miss Fanny Maxwell Moore, daughter of Charles A. Moore, of Brooklyn, performed the christening ceremony, and a number of prominent naval officers were present for the occasion. The "Porpoise" is one of five Holland submarine boats built for the United States Government. Her length is 64 ft. 4 inches, and her beam 11 ft. 9 inches. Her displacement when submerged is 120 tons. When steaming along the surface she is to be propelled by a 160-hp gasoline engine, and when entirely submerged by a 70-hp electric motor. Her estimated speed will be 8 knots an hour on the surface and 7 knots an hour under water. Five Whitehead torpedoes constitute the armament of the "Porpoise."

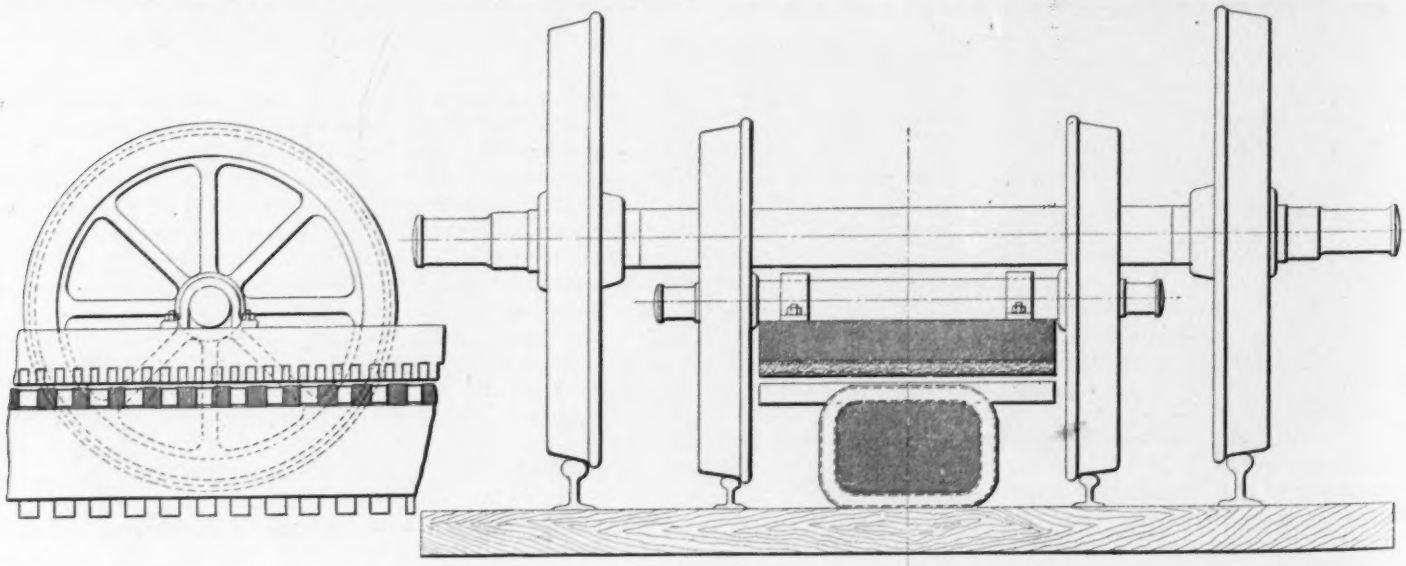


FIG. 2.—TANGENTIAL TRACTION ELECTRIC RAILWAY SYSTEM.

Changing a Magneto Drop to a Central Battery System.

BY CHARLES L. GOODRUM.

THE officers of Atlantic Coast Telephone Company in April decided to improve its plant at Atlantic City by the adoption of the central energy system. Owing to the short time available for the work in order to have it finished in time for the summer season, and also for the reason that a new switchboard and instruments would practically mean the purchase of a new plant, it was decided to transform the present system without displacing the switchboard and old instruments, and for this purpose the services of the writer were secured.

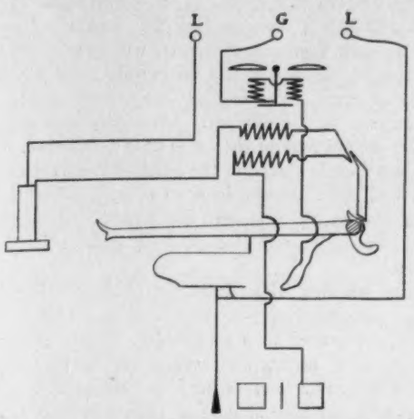


FIG. 1.—DIAGRAM OF CONNECTIONS AT SUBSCRIBER'S STATION.

The installation consisted of a magneto drop of 1300 subscribers' capacity. The present general battery system is of the transfer type,

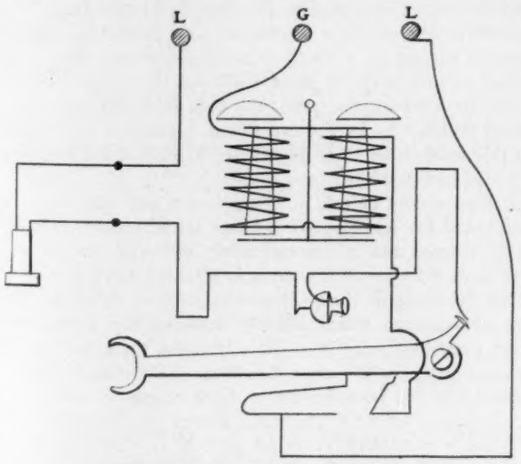


FIG. 4.—DIAGRAM OF REWIRING.

with five pairs of trunks from each section to every other section. Following is the method pursued in changing over while at the same time keeping up the service:

Fig. 1 shows the means whereby at the subscribers' station, and with the receiver on the hook, one side could be left open and the other grounded through the ringer. This enabled ringing over one line and ground. By grounding the common side of the drops on the switchboard, the subscriber could call central by turning the ringer crank in the usual way. The next step was to set up 11 cells of storage battery, the negative being grounded. The circuit is shown in Fig. 2.

When a subscriber rang up, the drop was not affected but (he did not know this) the drop fell when he took down his receiver. Two sections were changed each night, and after all sections were changed, several men were sent out to take off cranks and test the telephones, when it was found that the service was intact. At the same time the cord signals were arranged as shown in Fig. 3. The tip of one plug was connected to the tip of the other plug of that pair, and one sleeve to the other sleeve. In the center a 200-ohm relay was tapped. It will be seen that the plug connects to the positive side of the battery in the jack on the tip, and to the negative through the relay. The supervisory signal burns while the receiver is off the hook and responds to the movement of the hook at the station connected with that plug. Having this done, the old telephones were wired, as shown in Fig. 4, and much to our satisfaction it was found that the transmission was excellent.

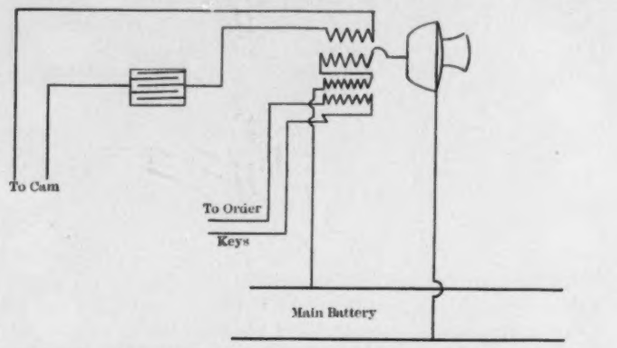


FIG. 6.—CONNECTIONS WITHOUT TRANSMITTER BATTERY.

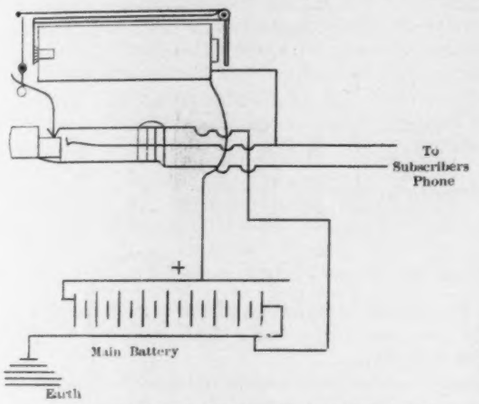


FIG. 2.—DIAGRAM OF BATTERY CONNECTIONS.

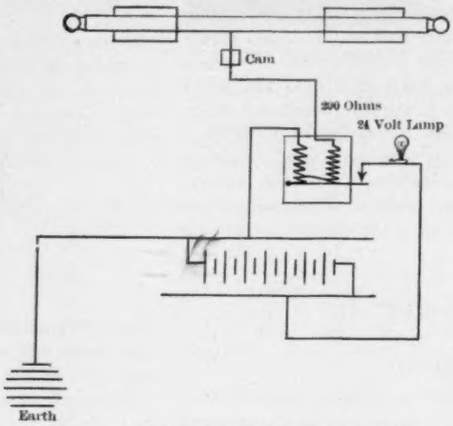


FIG. 3.—ARRANGEMENT OF CORD SIGNALS.

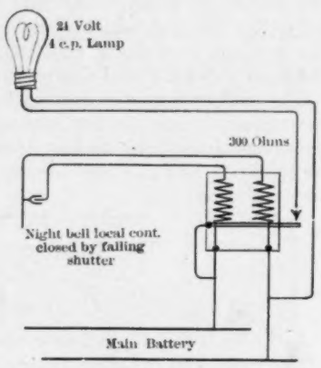


FIG. 5.—PILOT LAMP CONNECTIONS.

The next step was to put a pilot lamp on each section, as shown in Fig. 5, by using a relay wound to 150 ohms in each spool and connected as shown, the local thus causing no trouble through contact with other wires coming from the battery. The next move was to get rid of the operators' local transmitter battery on the switchboards, which was done as indicated in Fig. 6. The resistance of the primary and secondary of the induction coils was 100 ohms each.

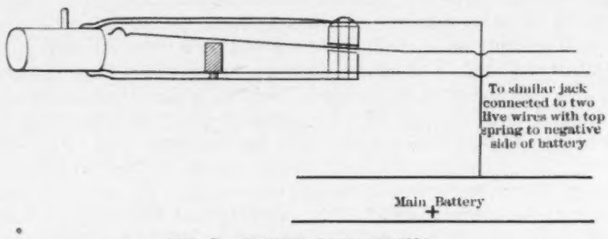


FIG. 7.—TRUNK JACK SPRING.

The plant was now working on the central energy system, and the principal trouble was found in trunking from one section to another, there being no check to show if the connection was to the proper trunk. This was remedied as follows:

In Fig. 7 the trunk jack spring is connected to the negative side of the battery, while the spring and the frame of the jack are not in contact with the plug of that trunk. This applies to the negative of the battery to both sides of the trunk. Having all trunk jacks, as in Fig. 7, six pairs of trunk cords were put in each section. Twelve pairs of regular cords and plugs did all the work, and with six trunk cords this made 18 pairs to each section. One of the trunking cord circuits is shown in Fig. 8.

When the operator gets a call she answers in the ordinary way, the supervisory lamp on the pair of cords used lights up, showing that the caller is at the telephone, and when she ascertains what

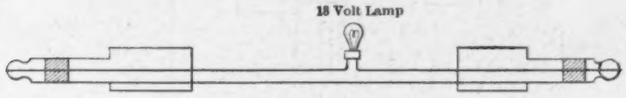


FIG. 8.—TRUNKING CORD CIRCUIT.

number is desired she then calls for the connection to be made on her trunk from the section number wanted. The supervisory lamp is then extinguished until the trunk is put in the jack called, which shows that the trunk is ready when she rings up her party. Should the operator misunderstand or otherwise not properly connect the trunk, her supervisory lamp in the trunk cords will burn, while if correct it will not light up until the first operator disconnects. The reason why it lights up is that the lamp is between the tips, and one plug being in the regular line jack, it is positive at one tip, the other plug being in the trunk jack, it becomes negative, whereby the lamp is lighted until the plug is put in the other end of the trunk, which disconnects the negative and puts the lamp out of circuit. When a subscriber has finished, his supervisory lamp goes out, and when the operator disconnects, this act lights the trunk lamp, and when she takes down the cord this results finally in clearing both ends.

The exchange as transformed has 1200 telephones, and is giving very good service, the old apparatus answering as well as central energy apparatus and the best of transfer boards. This method can be applied to any magneto drop by arranging the circuits to suit the jack and drop.

The Inductor Alternator—I.

BY EDWARD HEITMANN.

ALTHOUGH the inductor alternator has been in use for many years, and has given universal satisfaction, the idea seems still to prevail in some minds that the design is such, that it will not lend itself to the requirements imposed by the various engineering conditions of the present time. This paper has been written with the object of dispelling this unnnecessary fear, and to convince those interested that this type of alternator, when properly designed and constructed, will readily meet the most severe conditions encountered in the operation of generators of all sizes and types.

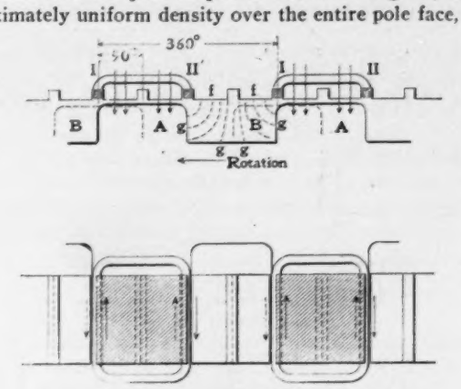
It will briefly discuss the electrical and magnetic features of this type of alternator, describe the mechanical construction, and, perhaps of most importance to central station men, will give the characteristics and data of a few machines, fully illustrating the actual operation under working conditions.

There are several mechanical and electrical details to be described which will be better understood and appreciated if the magnetic and electrical relation of the parts are first discussed.

As in all other dynamo electric machines, the generation of the e. m. f. depends upon the inductive action of a magnetic field upon conductors placed in armature slots, but the distinguishing features are the disposition of this magnetic field in a plane parallel to and passing through the axis of the rotating member, and that both the armature and field coils are placed on the stationary part of the machine. The revolving element, usually called the "inductor," consists of a cast steel mass of proper construction, the periphery containing polar projections which in sweeping past the armature windings induce therein an e. m. f. The exciting coil is usually a single stationary coil properly disposed with reference to the magnetic circuit. It follows that all the poles on one side of the machine are of the same polarity. Fig. 1*a* represents a developed portion of the armature surface with the corresponding poles. Let the direction of rotation and of the flux be as indicated by the arrows. The winding of one phase only is shown. With the poles in position *A*, no e. m. f. will be induced in the winding. However, as they move toward the left, leg *I* of each coil is subjected to the action of the flux and generates an e. m. f. directed perpendicular to the plane of the paper and downward, which rises to a maximum when the poles are in position *B*, and again falls to zero when the poles lie between legs *I* and *II'*, thus completing one-half of the cycle. The direction of the current is shown by the full line arrows in Fig. 1*b*. Leg *II* of each coil will now generate an e. m. f. which, as before, will be directed perpendicular to the plane of the paper and downward, and which will pass through a similar cycle. The broken line arrows in Fig. 1*b* now indicate the direction of the current. Obviously this direction is reversed, and the second half of the cycle thus completed.

If a second winding is placed in the slots midway between the winding shown, it will have induced in it an e. m. f. differing in phase by 90 degs. from that in the first, and the whole will constitute a two-phase winding, similarly, with slots 60 degs. apart a three-phase winding is obtained.

The armature winding of an inductor alternator is usually of the style known as concentrated windings, that is, all the conductors per pole per phase are placed in a single slot. Since the instantaneous value of the e. m. f. induced in such a coil is proportional to the strength of the magnetic field which it is cutting at that instant, it is apparent that with the pole shaped as shown in Fig. 1*a*, and having an approximately uniform density over the entire pole face, the curve



FIGS. 1*a* AND 1*b*.—INDUCTION ALTERNATOR.

which represents the instantaneous values of the e. m. f. throughout the cycle will not be a sine curve, but a flat-topped curve, which comes to zero quite abruptly.

An approximation to a sine curve may be obtained by distributing the winding in two or more slots per pole per phase, or by properly shaping the pole piece, so that the air gap density will vary in some definite way. Both of these methods will again be considered.

Since with a fixed impressed m. m. f., the magnetic fluxes through two parallel paths are inversely proportional to their respective reluctances, it will at once appear that a field must exist between the polar projections as indicated by the lines *fg* in Fig. 1*a*. This is the leakage field of the inductor alternator, and extends as shown from the armature surface between the poles to the iron parts beneath.

The field rotates with the main field and therefore reacts on that portion of the winding not under the pole face, inducing an e. m. f. opposed to that set up by the main field. Hence it is of importance to keep this field as small as possible. A method for accomplishing this will also be considered later.

As has been shown before, all the poles on one side of an inductor alternator have the same polarity, hence the armature teeth and iron are always magnetized in approximately the same direction. When the tooth is directly under a pole, it is working at its maximum density. This decreases as the tooth immerges from under the pole, and becomes nearly zero when midway between the poles, increasing again to a maximum when it is directly under the following pole, but always magnetized in the same direction. Likewise, in the armature body, excepting that here there is a slight change in direction, owing to a small angular swing of the flux. Hence *the direction of magnetization is never completely reversed*, as it is in other types of alternators, but *merely increases from a zero to a maximum value and again decreases to zero with a nearly constant direction.*

A thorough appreciation of this fact is necessary, for upon it depends to a large extent the economical design and good operation of

inductor alternators. Since the iron is worked only through a partial cycle, the iron losses must be extremely small if worked at ordinary low densities, or it can be worked at very high densities without bringing the losses up to those found in other types. Also, since the magnetic flux follows a radial path through the iron to the magnet bars, the radial depth of the armature laminations is determined entirely by mechanical reasons. If the armature and winding are designed with this point in view, the radial depth of iron can be made much less than in revolving field alternators. Having but a single coil for excitation, the copper required is reduced to a minimum and therefore the field C^2R losses are small. Owing to the low iron and field losses, and the extremely good ventilation obtained with the style of inductor adopted, the armature losses can be taken high without loss in efficiency or excessive heating. It would at first appear that if only one-half of the winding is effective at a time either the amount of copper or the amount of iron must be twice as great as in an alternator in which the whole winding is active. However, the above shows this is not the case, and as a matter of fact, the active material in a properly designed inductor alternator is but very little in excess of that in other types. Another fact of interest is that working the teeth at such high densities as are possible in inductor alternators results in a remarkable improvement in the regulation. This will again be considered later.

Enough has been said to show that the entire design tends toward a machine of good full load efficiencies, and owing to the low iron losses, one of very good efficiencies at partial loads. It will be shown later that the regulaion can be made equally satisfactory.

An Improved Apparatus for Arc-Light Photometry.*

The paper describes a photometric equipment which, while embodying certain features of Blondel's apparatus, combines simplicity of operation with adaptability to either open or enclosed arcs. A mathematical presentation is given of the theory of the apparatus, from which the conclusion is drawn, that to produce on the photometer screen an illumination proportional to the mean spherical intensity of the source, it is necessary (1) to direct towards the photometer the beams of light which the eye of an observer would receive if he were to view the source at angular intervals of 15 degs. in a vertical plane, and (2) to reduce the intensity of the light in these directions in the ratio of the sine of the angle between the direction of view and the vertical.

In carrying out the method, a ring (Fig. 1) of 24 large trapezoidal mirrors, M, M, surrounds the arc. This system of mirrors constitutes a truncated, 24-sided pyramid. The inclination of the mirrors to the axis A of the system is such that the eye, placed at the photometer P, sees 24 images of the lamp L, of which L' is the horizontal one, precisely as if the mirrors being absent, one were to travel in a circle about the arc in the plane oo' stopping at 15 degs. intervals.

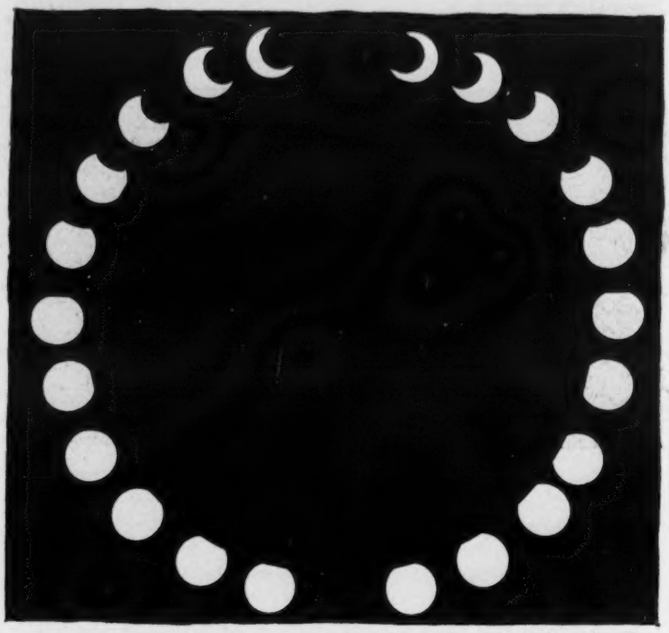


FIG. 2.—IMAGES IN DETERMINING SPHERICAL CANDLE-POWER.

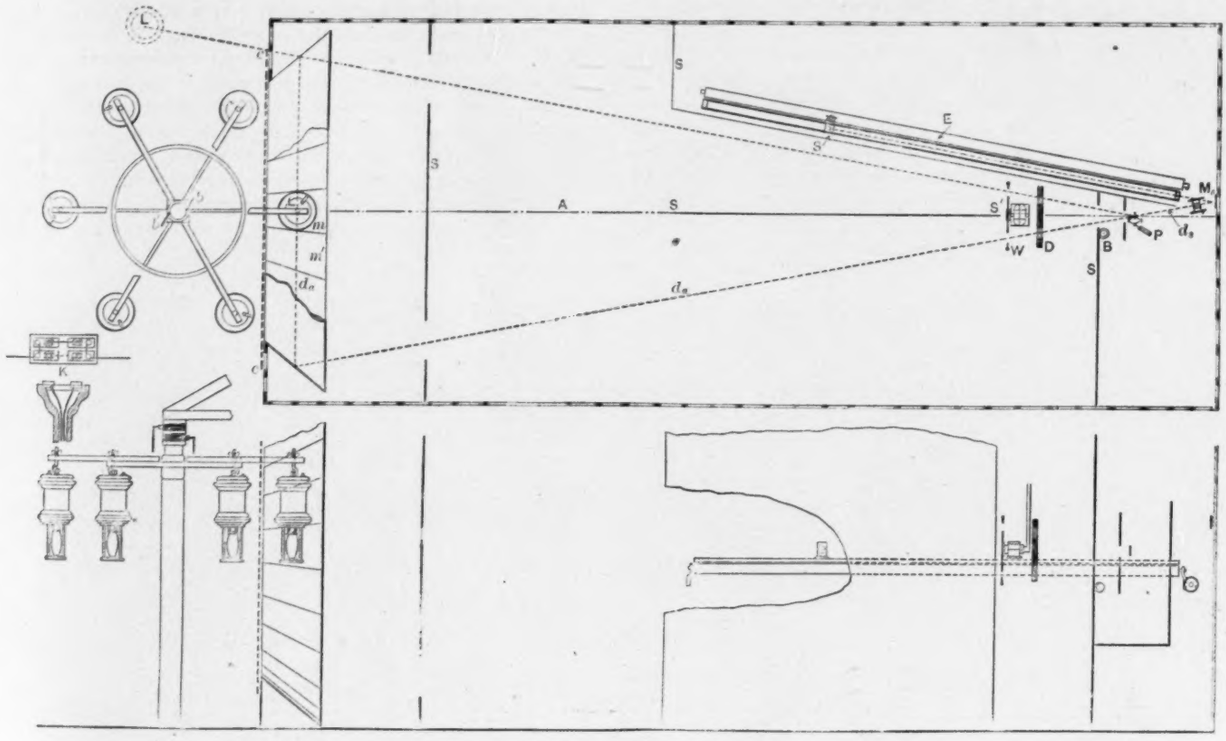


FIG. 1.—ARRANGEMENT OF APPARATUS.

Figs. 2 and 3 show the aspect of this series of images from a point near the photometer. The slight amount of displacement shown in these illustrations is due to the fact that the camera could not be placed at the optical center of the system. Fig. 2 shows the entire set of images as used in the determination of the mean spherical intensity, and the Fig. 3 the lower images only for the determination

*Abstract of a paper read Sept. 27, 1901, before the American Institute of Electrical Engineers.

of the mean hemispherical intensity, as in the case of lamps with shades. As actually used, the top and bottom mirrors were left out, not because there may not be light in these directions, but because these intensities, when multiplied by sin O, do not contribute to the mean spherical intensity. Direct light from the arc is intercepted by a black screen *S*.

This system of mirrors serves then to direct the light to the photometer screen in the chosen directions. The second condition is

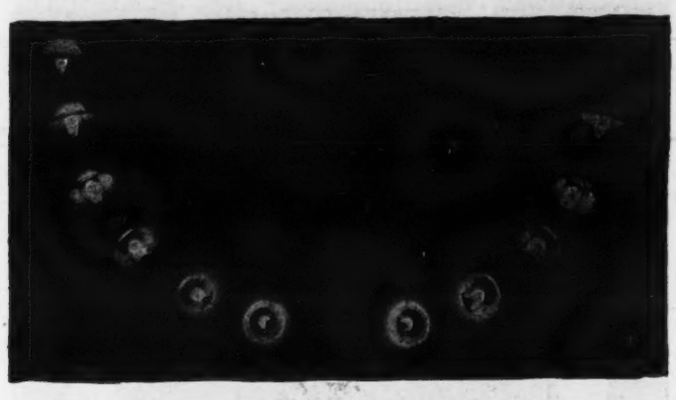


FIG. 3.—IMAGES IN DETERMINING HEMISPHERICAL CANDLE-POWER.

that the intensity of each beam of light shall be reduced in the ratio of the sine of the vertical angle. This has been done by a polygonal glass disk *D*, composed of as many sectors as there are mirrors. These sectors are smoked until they give the desired absorption. In order that the film of smoke may be permanent, the ring of smoked sectors is covered by two plates of plane glass. These plates cover but do not touch the smoked surfaces. The three thicknesses of glass are firmly bound together, and the screen, as a whole, may be handled without fear of changing its absorption. The precaution must be taken to thoroughly clean its external surfaces before making measurements. An essential condition to the success of this method is that the photometer screen should receive through any given sector from the image in the corresponding mirror and from no other. That this condition is fulfilled, can easily be determined. Thus, if all the mirrors be covered except the horizontal one, and all the sectors be covered except the sector just above the horizontal, that is, at 15 degs. A, then if the patch of light produced by this arrangement of the apparatus falls not upon the photometer screen, but upon the black surface in the vicinity of the photometer, the required condition is met. The sectored disk is best put in place by replacing the photometer screen by a cardboard pierced by a small opening. The observer can then sight through this hole and ascertain the adjustment of the disk with reference to the system of mirrors.

The mirrors are of good quality, French plate glass. Their reflection coefficients were carefully determined for the incidence at which they are used. Some inequalities were found, as would be expected, although the maximum difference from the mean value of .815 is only + 2.9 per cent. However, in order that the apparatus might be used for the measurement of steady sources, variations of the coefficient were corrected by smoking of the corresponding glass sectors. That is to say, if the coefficient of a particular mirror were high, the corresponding glass sector was smoked a little heavier than would otherwise be done.

Some care and skill are necessary to produce a uniform coating of smoke of just the required density. It was found convenient to use a sheet iron chamber, fitted with a suitable flue, and pierced near the top with a small opening for the introduction of the glass. This chamber must be placed near one end of the photometer bar in order that the absorption of the glass may be tested as frequently as may be necessary. The setting of the photometer being predetermined, each sector is smoked until it shows the required absorption. There is a tendency for the coating to form most heavily near the edges of the glass. This may be overcome by providing a guard ring of glass of the same thickness as the piece to be smoked, the whole being mounted in a convenient holder. The best results will be obtained by holding the piece of glass vertically in the smoke chamber, occasionally reversing the piece. Turpentine is a good combustible, but it must be introduced into the receptacle at the base of the chamber in small quantities, otherwise the combustion will be so violent as to produce a flocculent deposit on the glass.

In testing the glasses it is best to use a small source of light, such as a narrow slit in front of a straight filament glow-lamp. Any inequalities in the coating of smoke can be detected by moving the glass about in front of this opening, care being taken that the same plane is maintained. It will be seen in Fig. 1 that the incidence of the light upon the glass is not quite normal. Care was taken to maintain this same incidence in the absorption tests.

At M_s is shown a mirror for directing the light from the temporary standard to the photometer. This mirror might have been omitted had not the limits of the photometer room already been taxed to the utmost. Still better, if the mirrors were from one large piece of glass, the direction of the photometer bar might be such that the same incidence would be had on M_s as upon the others. In this case the correction for the mirror absorption would be eliminated.

The illumination upon the arc side of the photometer screen is, of course, very intense. It is necessary to reduce this illumination. For this purpose there was used a rotating wheel *w*, provided with a large number of narrow radial slots. It is quite essential that the number of open slots should be large, as otherwise the illumination on the photometer screen will be seen to beat or pulsate when measurements are being made on the alternating arc. In order to avoid this the constant of this wheel was determined by direct experiment on the arc itself, and not by calculation. The mean of several determinations gave the transmission constant of the sectored wheel, K_w the value of .090. The number of slots in this wheel is 48, which gives a frequency amply great at the normal speed of the motor used for driving the wheel.

A possible source of error is the diffusion of the smoked glass disk. That is to say, since the disk receives a certain flux of light dependent upon the solid angle which it subtends from each image as a center and upon the intensity of such image, it becomes, to some extent, a secondary source. The direct measurement of this is a matter of some difficulty. To determine if the correction for this diffusion were of importance, the longitudinal screen *ss'* was removed, the mirrors to the left of the vertical were covered, and likewise the right half of the sectored glass disk. With an arc of ordinary intensity in the center of the mirror system, it is evident that the left half of the sectored disk receives a flux of light about equal to that which it would normally receive with the longitudinal screen in position and the mirrors entirely uncovered. At the same time, no direct light from the images falls upon the photometer screen. Any illumination perceived under such circumstances would be due to the diffusive action of the glass. As a matter of fact, it was found that with the temporary standard stopped down by a narrow slit, a setting could be obtained in this way when the sectored wheel was not in position, but when this wheel was running in its proper place the correction was entirely negligible. Hence no further attempt was made to take account of it.

The distance from source to photometer screen is large, being nearly nine metres. As the incidence of the light from the temporary standard is the same as that from the arc, no correction is here necessary.

The paper gives the deduction of the working equation of the apparatus, which, for the particular apparatus described, is as follows:

$$I_{ms} = 1.17 \left(\frac{865}{d_s}\right)^2 I_s \quad I_{mhs} = 2.01 \left(\frac{865}{d_s}\right)^2 I_s$$

where I_{ms} is the mean spherical intensity, I_{mhs} the mean hemispherical intensity, I_s the standard of intensity, and d_s the distance

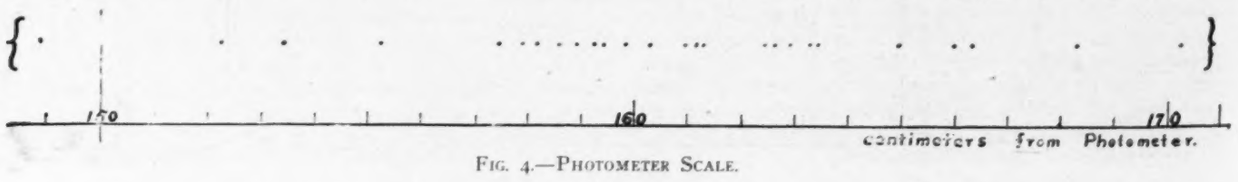


FIG. 4.—PHOTOMETER SCALE.

from the temporary standard to the photometer screen, this value being recorded on a drum. A single covering on a drum suffices for the record of many tests, and the records may be worked out at the leisure of the operator. Fig. 4 gives a specimen record and shows the usual range of fluctuation. The number of settings here is 30. This large number is necessary because of the fluctuations in the intensity of the arc, even with the steadying effect peculiar to the multiple mirror method. With hand fed arcs, a smaller number will suffice to give a value representative of the average performance of the arc. For the distribution curves, it suffices to uncover the mirrors in pairs and make settings in the usual way. The appropriate mirror constants must, of course, be used in working up the results.

As a check on the accuracy of the integrating method as compared with the usual method: The results are given of a test on an arc of the enclosed type. The value obtained from the Rousseau diagram is 308. That by the method described in this paper, 319. This agreement is within 3.4 per cent. When one considers the difficulty in maintaining an automatic feed arc under constant conditions during the time required to take the distribution curve, this must be considered as a very satisfactory agreement.

Electric Automobilism in the Sandwich Islands.

THE Hawaiian Automobile Company was organized in the year 1899 and began operations in the year 1901, doing a general livery business in Honolulu, and during the early part of its operations was well patronized by the public and very successful. Its complement consisted of twenty special surreys of the type shown, one trap, one family surrey and five runabouts, all using electricity as a means of propulsion. The steam plant consisted of two 100-hp Babcock & Wilcox boilers, with Green fuel economizer, steam heater and separator, and two 11½ by 10 McIntosh & Seymour high-speed engines direct connected to two 60-kw, 125-volt shunt-wound General Electric Company's generators. The plant was also fitted with a Spencer damper regulator and a 9-inch Westinghouse air pump used for compressor purposes. The switchboard, as shown in the engine room, is fitted with both indicating and self-recording volt and ampere meters. The switchboard for the battery room is of special design, and was built at Schenectady by the General Electric Company, and is so arranged that all the batteries and vehicles on charge in the building can be regulated from this board. This board is connected with the main board by cables through subway, the cables having a capacity of 1,500,000 circ. mils. In the battery room, for the handling of the batteries, a traveling frame is provided from which is suspended a 2000-lb. capacity Pneumatic Tool Company's hoist, and for placing the batteries in the vehicles and taking them out, a push and pull

FIG. 2.—HAWAIIAN ELECTRIC SURREY.

ram made by the American Bridge Company, especially designed for this work, was erected. The batteries are charged upon benches, as shown, and the current is controlled by Cutler-Hammer rheostats. In the main room charging plugs are provided around the walls for charging vehicles without removing batteries. To replenish the batteries with electrolyte, a large acid tank is erected at an elevation of 12 ft. above the floor, and from this hard rubber piping is led around the entire battery room with suitable stop cocks and rubber pipe connections for putting fluid into any set of batteries in the room. Large sinks are provided in the battery room for the cleaning and washing of elements, the floor of this room being laid with a pitch to center for drainage purposes.

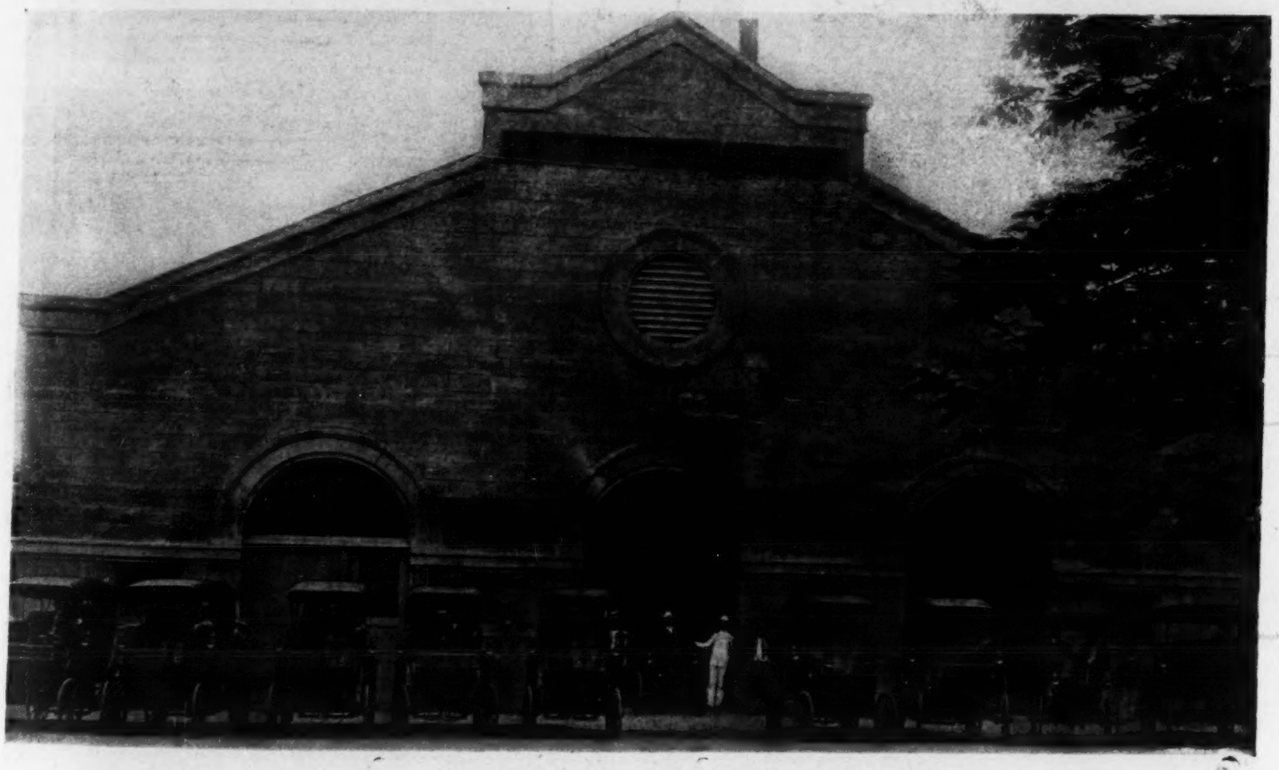


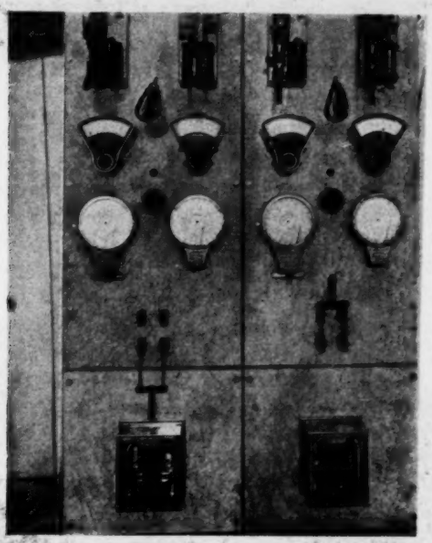
FIG. 1.—EXTERIOR OF AUTOMOBILE STABLES, HONOLULU, SANDWICH ISLANDS.

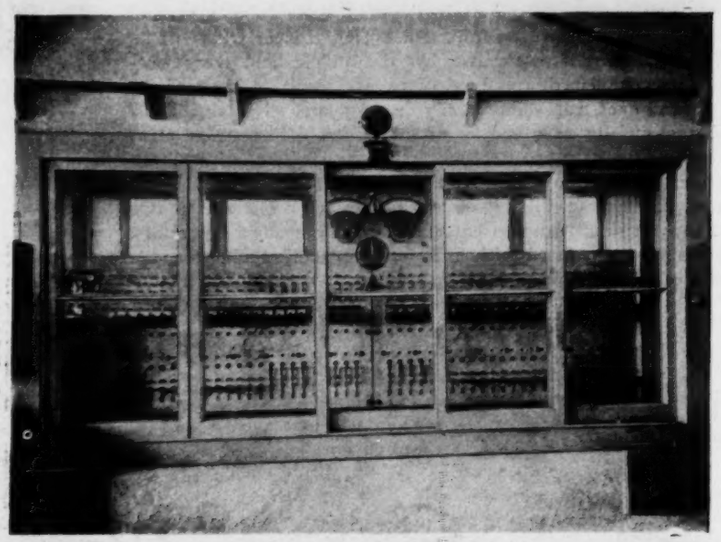
The building itself is of concrete, steel reinforced and built under the Rankin patents, cement floored throughout, and has high-light-

FIG. 3.—CHARGING ROOM, HONOLULU.

FIG. 7.—AN AVERAGE HONOLULU STREET AND ROADBED.

ing. The walls have a height of 22 ft in the clear, and the entire building is roomy and cool. Large wash pits have been provided on the outside of the building in the yard for washing carriages and also a suitable repair pit on the inside for making repairs on motors when needed. Everything about the plant is strictly first-class in construction and as up-to-date as possible, it being the intention of the promoters of the plant to leave nothing out that is necessary to a first-class establishment of this kind. A complete oxyhydrogen lead





FIGS. 4 AND 5.—SWITCHBOARDS, HAWAIIAN AUTOMOBILE STATION.

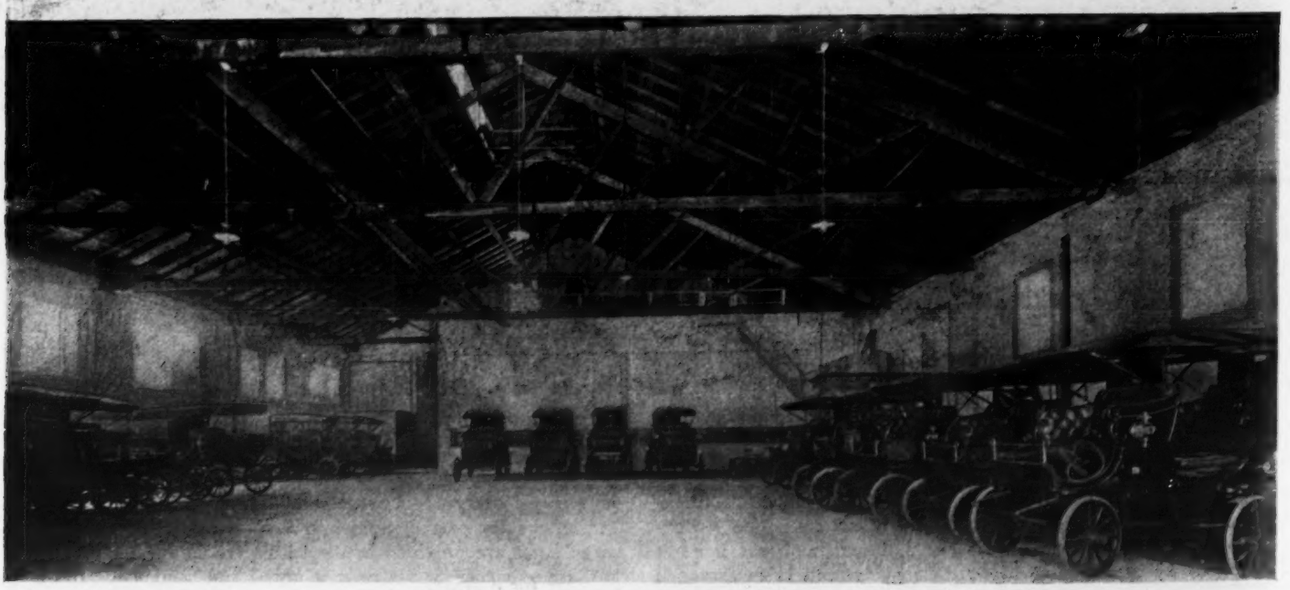


FIG. 6.—INTERIOR VIEW, AUTOMOBILE STATION, HONOLULU.

burning apparatus has been provided for making repairs and renewals to the batteries.

This plant has at the present time temporarily suspended operations on account of the deterioration of the batteries at first in use, which prevented the company from successfully operating its vehicles, and Mr. Louis T. Grant, the general manager and designer of this excellent plant, is now in the United States studying the battery problem with a view to securing a battery whose deterioration will not interfere with the steady commercial manipulation of this station. The plant has been built and operated under the immediate supervision of the above named gentleman, and it is his hope and expectation that the public service of the system may be continued and developed in the near future. The principal promoters to whose energy is due the organization of the company are Mr. E. D. Tenney and J. B. Atherton, two of Hawaii's leading and most progressive citizens. Honolulu itself is a practically ideal city for the automobile business, having fairly level roads, most of which are macadamized and grades are practically slight. With its even temperature the year around, the people ride a great deal in all seasons, and it is sincerely hoped that this venture, representing an outlay of nearly $150,000, will prove successful.

Electricity and the Royal Visit to Canada.

DURING the past week or two our Canadian friends have been celebrating the visit to the Dominion of the Duke and Duchess of Cornwall and York in a very loyal and enthusiastic manner. As might have been expected, electricity has played a most conspicuous part in the illuminations, while one of the special features has been the building of a royal trolley car for the use of the royal pair. It is the only car of the kind, if exception be made of one which is said to have been built for the Emperor of Korea, and equipped like this one by the Westinghouse Company. For details as to the Canadian car we are indebted to Mr. T. Ahearn, president of the Ottawa Electric Company, who has also been kind enough to send us photographs.

The first electric car thus provided for the exclusive use of European royalty has been furnished by the Ottawa Electric Railway Company, and is called "The Duchess of Cornwall and York," after her royal highness. The brake and motor equipment are entirely of Westinghouse manufacture. Four railway motors of 50 horse-power each drive the car at a speed of 50 miles per hour, and at this high speed the motion is entirely controlled by automatic air brakes. The car is 50 ft. in length, with straight sides and vestibuled at both ends, with full monitor roof of the Pullman pattern. The color of the car is also Pullman standard, with the British coat of arms conspicuously displayed on its front and rear. The interior is finished in antique polished oak, with a handsomely decorated ceiling of three-ply bird's-eye maple veneer. At either end of the car and set in frames are two large British plate mirrors that greatly enhance the beauty of the interior decoration. Rich bronze trimmings —the hatracks, hooks, etc., are of solid bronze—heighten the luxuriousness, and at night the car is resplendent with the illumination of five clustered groups of incandescent lamps in handsome fixtures. A rich royal blue velvet carpet covers the floor, and from the windows hang highly ornamental curtains of the latest pattern. For the comfort of the royal occupants, large, easy chairs, beautifully upholstered in olive-green plush, are provided.

As to the special lighting in Ottawa, our correspondent in Canada writes that those who looked in the direction of Ottawa, from outside quarters, during the four nights which the Duke and Duchess of York remained at the capital of the Dominion, might have been excused if they imagined that a second great conflagration was devastating the city. The electrical decorations have never before been equaled in Canada, and for chasteness and originality of design have never been surpassed in the world. Superb as were the illuminations in general throughout the city, the acme of electric splendor was reached on Parliament Hill, Major's Hill Park and the new Interprovincial bridge which spans the river between Ottawa and Hull, and which is at present the largest cantilever bridge in the world.

The scheme of the government electrical illuminations was largely followed out along the lines so successfully adopted at the Pan-American Exposition. The Gothic style of architecture of Canada's Parliament and departmental blocks afforded a scope for even better electrical effects than the renaissance of the Buffalo buildings. The great buildings were outlined in incandescent brilliancy, in tower, turret and facade, the arched lines of the doors, windows, pinnacles, etc., being picked out in thousands of incandescent lamps, while high above, at the apex of the central tower, gleamed an electric crown which could be seen for many miles away. In addition to

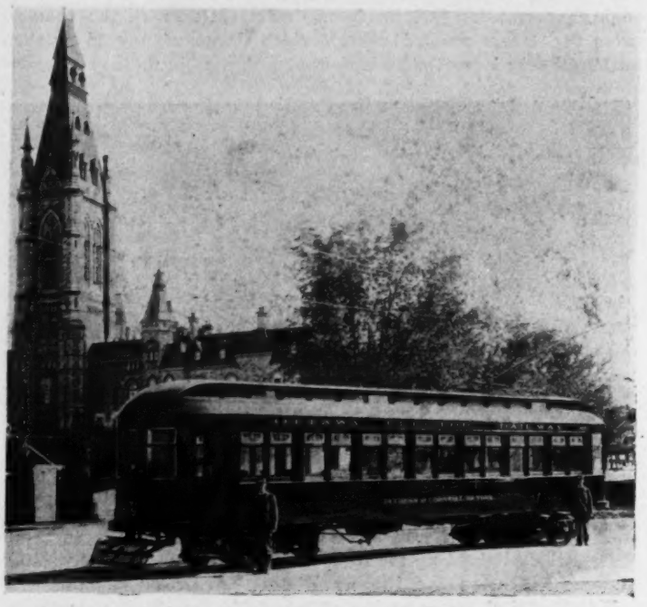


FIG. 1.—THE ROYAL CAR, OTTAWA.

these illuminations, the hedges and trees on Parliament Hill and Major's Hill Park adjoining were hung with myriads of electrically lighted Parisian lanterns. In the flower beds and among the foliage glowed numberless red, green, blue and yellow electric lights, producing the effect of gorgeously tinted flowers and opening buds. On the Inter-provincial bridge gleamed 10,000 electric jets. The outlines of this great structure were strictly followed and illuminated by rows of 10-cp lights. Surmounting the center span were the words "Royal Alexandra," the name given the new bridge, and formed of electric letters, each letter being 12 ft. high and the whole 200 ft. in length. Roughly estimated, not less than 100,000 electric lamps were used in the decorations and illuminations throughout the city.

But there were interior electrical displays, which rivaled the mag-

FIG. 2.—SCOTTISH ARCH ON DORCHESTER STREET, MONTREAL.

nificence of the exterior show. The preparations for the illuminations of the Parliament and other public buildings had been in progress for fully two months past, under the supervision of the Ottawa electrical engineers, Messrs. Ahearn & Soper. A great surprise was in store for such as were favored to view it. In the Senate Chamber, where their Royal Highnesses held the drawing room, the electrical preparations of the firm's experts had been quietly carried on behind closed doors, and when Ottawa's fashion and beauty entered the Red Chamber they received their first glimpse of a scheme of decoration, that for delicacy and refinement of treatment and for

dazzling magnificence, has probably never before been equaled in this line. All gasoliers and electroliers had been permanently removed from the chamber, and the old heavy panelled ceiling had been replaced by one composed entirely of luxifer prisms, through which the soft rays of 1000 incandescent lights, placed above and out of sight, penetrated. Just inside the main entrance of the chamber were two flower stands, between which the guests passed on their way to the throne. Amidst the growing flowers in these stands were

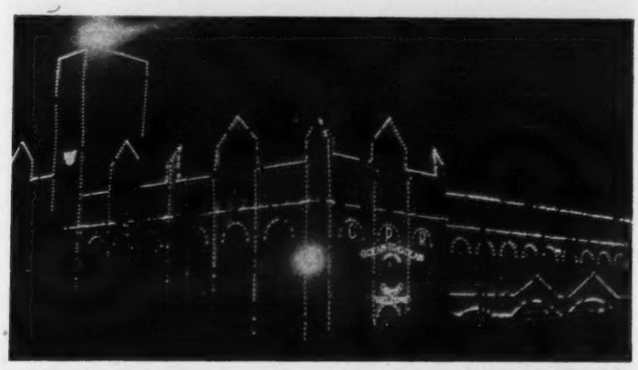


FIG. 3.—C. P. R. STATION, MONTREAL.

hundreds of Duchess of York roses made of Bohemian glass. Inside the roses, and concealed by their petals, were tiny incandescent lamps which lighted up the roses with a mellow glow. Two similar flower stands were placed to the right and left front of the throne.

The beautiful gothic arches of marble in the chamber were outlined in hundreds of incandescents of the size of grapes. Beneath the arches and resting against the panels of the chamber were hung festoons of smilax and electric roses. Each festoon was joined at the junction of the base of the arches with a wreath of smilax and electric roses through which, as in those of the festoons, glowed a soft, entrancing light. On each side of the throne stood a column upholstered in red plush and mounted with the new royal crown having nine pearls on each side. These pearls consisted of miniature incandescent lamps, pearl shaped and frosted. The columns were entwined with smilax and miniature lamps.

The piece de resistance, however, was the throne dais itself, upon which stood the Duke and Duchess and the Governor-General and

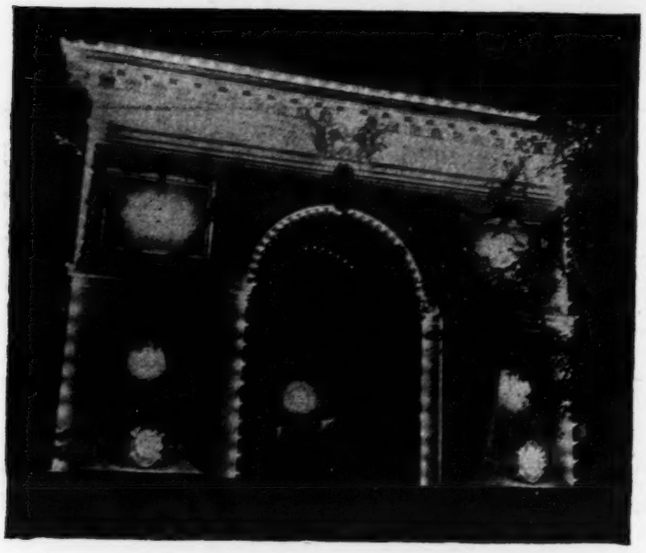


FIG. 4.—CITIZENS' ARCH, MONTREAL.

Lady Minto. Ordinarily the drapery of the throne is beaded perpendicularly, at intervals of about 2 inches, with gold and crimson cord. On this occasion the beads were composed of miniature electric lamps. Above the throne and forming a canopy of diamonds over the royal party were thousands of miniature electric lamps, radiating from a central point and drooping in graceful curves to the columns on either side to which they were attached. Nothing more beautiful and alluring could be imagined, and a greater artistic triumph in electric lighting it would be difficult to attempt.

Nor was Ottawa alone in these efforts, for we are enabled to show some of the effects obtained at Montreal, for the photographs of which we are indebted to the Mr. Charles Brandeis, of the Lachine Rapids Land & Hydraulic Company, which alone supplied over 15,000 special lights for decorative purposes. Among the buildings, etc., thus provided were the company's own offices, 1500 lights, the Canadian Pacific Railroad's Windsor Street depot, with 3500 lights; the St. James' Club, with 1150 lights; the Citizens' Arch on Sherbrooke Street, 900 lights; the Scottish Arch, 450 lights; the C. P. R. Place Viger depot, 2000 lights. The work thus carried out by Mr. R. S. Kelsch, the superintendent of the company, was most successful.

New York Rapid Transit Power Plant.

The New York Rapid Transit Subway Construction Company has selected and purchased the property which will be used as the site of its central station from which power will be supplied to the entire rapid transit system. This site consists of the block bounded by Fifty-eighth and Fifty-ninth streets, Eleventh and Twelfth avenues, together with the water front along the Hudson River opposite this block. The Eastmans Company has held the property at $1,000,000 as their selling price.

The power house to be erected on this block promises to be one of the largest establishments of its kind in the world. It will be built of brick, and will cover an area of 200 by 650 ft. Its equipment will consist of twelve 7500 to 11,000-hp engines, each one of which will drive a 5000-kw generator. To furnish the steam 72 1200-hp boilers will be installed.

Mr. John Van Vleck, the electrical and mechanical engineer, speaking at the Subway Construction Company's office, stated that it was not possible for the present to speak in any great detail of the new power house, because the plans have not yet been fully developed. The work of clearing the site, preparatory to the construction work, will be begun in the near future, but just how soon Mr. Van Vleck would not say. It will take about two years to put up the building and install the machinery; in fact, it is the plan to have the underground railroad and the power house reach completion at about the same time. To have the power house finished before the road, it is pointed out, would simply mean tying up so much capital sooner than is necessary, and on this account it is not probable that the work on the former will be pushed immediately. Mr. Van Vleck would not venture an opinion as to the probable cost of the building with all of its equipment.

Telephoning the Hospice of St. Bernard.

Mr. John W. Gates, of the U. S. Steel Corporation, tells a story about a friend of his who went into the Alps last summer. "My friend began the ascent to the hospice of St. Bernard," said Mr. Gates. "When about an hour's climb from the pass he was stopped by a dense fog. He waited gleefully, expecting to be rescued by the dogs, and so be able to come back to us with a thrilling story. The dogs did not come, however, and the fog partly lifted, so he resumed his climb, and finally arrived at the hospice, where he was welcomed warmly by the brothers. His first question was:

"'Why did you not send the dogs out in so dangerous a fog?'

"He nearly dropped from his chair when one of the brothers said:

"'You did not telephone us.'

"'Telephone you?' he ejaculated.

"'Yes,' was the answer. 'You see, shelters have been built all along the climb, and each shelter has been provided with a telephone. If a fog comes up all one has to do is to go to the nearest shelter and telephone. We immediately send a man and dog to that shelter. The dog carries bread, cheese and wine. As we know at just what shelter the climber is no time is lost in looking for him.'"

Mr. Gates says his friend was so disgusted with having his romantic notions knocked in the head that he left Switzerland at once.

Independent Telephone Development.

It is now announced that Mr. C. W. Morse has secured control of the Telephone, Telegraph & Cable Company of America, and this week Mr. Morse stated that Judge J. M. Thomas, the well-known president of the National Independent Association, will be general manager of the organization under the new conditions, thus retain-

ing his old connection with it. In New York City the representative of the company would naturally be the Knickerbocker Company, and Mr. Morse states that they will "fight for a foothold in New York right away." In Boston the alliance includes the Massachusetts Telephone Company. In more or less close intimacy with this movement, two large telephone companies were incorporated this week in New York State. The Frontier Telephone Company, of Buffalo, with a capital of $500,000, has been formed, to operate a telephone system connecting Buffalo, Rochester, Syracuse, Utica, Albany, Poughkeepsie, New York City, Tonawanda, Niagara Falls, Lockport, Dunkirk, Erie, Pa.; Cleveland, Ohio; Jamestown, Elmira, Binghamton and Hornellsville, the directors being J. A. Stearns, of Wilkesbarre, Pa.; Alvin Mokle, of Hazleton, Pa.; J. M. Thomas, of New York City; E. C. Lufkin, J. B. Weber and C. B. Hill, of Buffalo, and F. R. Green, of Fredonia.

The other incorporation is the Seneca Falls Home Telephone Company, with a capital of $100,000, to operate in Seneca Falls, Tyre and Junius, Seneca County. The directors are Howard Hendrickson, of Albany; A. G. Lord, J. A. Drake, S. R. R. Rawson, F. H. Sudro, T. M. Brush, F. W. Martin and J. H. Griswold, of Elyria, Ohio.

CURRENT NEWS AND NOTES.

INTERNATIONAL GRIEF.—President Langdon, of the English Institution of Electrical Engineers, sent on Sept. 19 the following dispatch in behalf of that body to the sister society in this country: "President American Institute of Electrical Engineers: Members Institution Electrical Engineers, London, tender sympathy yourselves and American Nation in sad death President McKinley."

DIRECT TELEGRAPH TO THE KLONDIKE.—The all-Canadian Government telegraph line from Vancouver, B. C., to Dawson was completed on Sept. 24, and the first dispatch transmitted was a message of congratulation from Governor Ross, who was in Vancouver at the time, to his legal representative at Dawson. The line is 2200 miles in length and part of the route was that adopted for the Collins overland line in 1865.

AN ACCOMMODATING OPERATOR.—One of the latest stories concerning the telephone girl comes from a Bell exchange in central Illinois. A subscriber called for No. 126, which instrument was located at the home of an intimate friend. The answer came in an unfamiliar voice, and the subscriber discovered that she had been connected with No. 125. She rang off and called up central again, and the conversation that followed was something like this: "Say, central, you gave me the wrong number. I called for 126 and you gave me 125." "I know it," answered the operator, "but it was the best I could do. No. 126 was busy."

BOSTON EDISON PLANT.—The admirable article on the new plant of the Boston Edison Company, by Mr. E. S. Mansfield, has been reprinted in handsome pamphlet form, with an illustrated cover. This plant stands on the famous old tea wharf of revolutionary fame, and the design on the cover reprint shows a half-tone of the tea party episode surrounded by a line cut of the Edison Atlantic Avenue station. We are indebted to the John Hancock Life Insurance Company, of Boston, for the original picture of the "tea party" used for this purpose, and take this opportunity of expressing our thanks for their courtesy in this matter. The article appeared originally in our pages in the issue of May 18, 1901.

CHICAGO ELECTRICAL ASSOCIATION.—The subjoined is the fall and winter programme of the association: Oct. 4, 1901.—Telephone Protectors, by S. G. McMeen, Central Union Telephone Company. Oct. 18, 1901.—Proposed New Rating of Incandescent Lamps, by John D. Nies, instructor in electrical engineering Lewis Institute. Nov. 1, 1901.—The Storage Battery in Telephone Work, by James Glen Wray, electrical engineer Chicago Telephone Company. Dec. 6, 1901.—Demonstration of High-Frequency Effects, by Arthur Vaughn Abbott. Ladies' Night.—This meeting will be held in the auditorium of the Lewis Institute. Jan. 3, 1902.—Tests on High-Tension Service Lines, by George N. Eastman, testing department Chicago Edison Company.

ELECTRIC FURNACE.—A patent issued Sept. 24 to Leonard S. Dumoulin, of Flushing, N. Y., covers an electric furnace of the resistance type, designed with particular reference both to maintenance and repair. The primary heaters, two or more in number, are horizontal carbon rods, of reduced section within the smelting chamber, their enlarged ends resting in apertures in the furnace walls. The smaller central portion of the rods offers sufficient resistance to the current to develop the degree of heat required. and is protected from disintegration and from oxidation by the ores under treatment by means of a sheath of fire-clay, best applied in a plastic condition. The heavier uncovered ends remain comparatively cool by reason of their low resistance and the free radiation afforded by their exposed position. As a further protection and support these sheathed bars may be inserted within fire-clay tubes which traverse the walls and smelting chamber of the furnace. The construction is novel in detail only.

FRENCH SUBMARINE BOATS.—A cable dispatch to the *New York Tribune* of Sept. 28 says: The successful trials of the new submarine boat "Sirene" at Cherbourg have elicited from the naval authorities renewed expressions of confidence in this class of vessel. The "Sirene" was 24 hours at sea in rough weather, four hours of which she was under water, when she discharged torpedoes with ease and efficiency. Her qualities are rapidity of submersion, which is accomplished in five minutes from a stationary start; stability and habitability. Among the results of the submarine experiments is the decision of the submarines board of experts that submarines should never discharge their torpedoes at a distance of less than 100 metres from the object to be destroyed, because an explosion within that radius would destroy the submarine itself. Submarine craft are, from Oct. 1, to be placed in a department of their own, quite separate from the torpedo boat service, and with special stations at Cherbourg, Rochefort and Toulon, each under the direction of a naval captain. The officer appointed in this capacity at the Norman port is Captain Heilmac, who lately commanded the French guardship at Constantinople. He has been very successful in his technical studies, and is regarded as the highest authority on torpedoes and electricity.

INDUCTOR ALTERNATOR LITIGATION.—A decision was handed down last week in a suit for an infringement of an Eickemeyer unipolar dynamo patent granted May 25, 1886, on an application filed Nov. 8, 1882, the alleged infringing apparatus being an inductor alternator in the station of the Winsted, Mass., Gas Company. The patent in suit relates to a unipolar dynamo, the object of the invention of which was to produce a practically commutatorless direct-current machine. One of the claims of the patent is on a revolving armature enclosed by a magnetic shell, one or more helices being housed in the shell and arranged concentrically with the armature. The complainant, the General Electric Company, claimed that a S. K. C. inductor generator infringed this claim in that it employs a constant polar relation between the stationary and the rotary elements. The defendant—the Stanley Electric Manufacturing Company—denied that it uses a revolving armature, but the complainant contended that the term "armature" in the claim should be construed to mean the inner part which revolves, whether the copper conductors revolve with it or not. The court made a rather summary disposition of the various contentions of the complainant. The patent in suit, it said, covers a mere impracticable improvement upon the prior direct-current unipolar art, while the defendant's construction embodies a practical improvement in a distinct alternating-current inductor art. "For twenty years the courts have been struggling so to develop the patent law as to protect the rights of the contracting parties and to give full meaning to the promise implied in the constitutional grant, "to promote the progress of useful arts by securing to inventors the exclusive right to their discoveries." * * * When, therefore, an inventor, claiming only to be a mere improver upon an art previously confessedly impracticable, is admitted to the race by a patent granted on a theoretical utility, but finds no practical method to surmount the obstacle or break down barriers which have closed the way to his predecessors, while his machine may still keep its place in the chosen path, yet, having no inherent capacity for forward movement, the inventor will not be permitted to drag it across the whole road open to the world of invention and pervert the purposes of his admission to promote, by obstructions to prevent, the progress of the useful arts." The bill was dismissed.

LONDON-BRUSSELS TELEPHONE LINE.—The first cable for a telephone line between Brussels and London has just been laid. The distance is 250 miles, 56 of which will be under water. The cost of the construction of the line will be £36,000.

PEACHES FOR BUFFALO, N. Y., are now reaching that city by trolley car from the Lake Ontario peach district, the peaches arriving in fine condition, fresh and unbruised. On one day 350 baskets thus arrived from Olcott Beach over the trolley route. This prompt access to a large market is much appreciated by the public, the dealers and the growers.

STAND UP FOR FOUR CENTS.—The local transportation committee of the Chicago City Council has recommended that transfers shall be issued at all the junctions of the lines of the same street car company and that passengers who are not given seats shall only pay four cents. The impracticability of the last clause has already been pretty well proved. The conductor of a crowded car trying to keep track of the four-centers who got seats would not be a man to envy.

SINGLE-PHASE RAILWAY.—In a discussion of a paper on the Zossen high-speed railway read at the Glasgow Engineering Congress, Professor H. S. Carhart said that he knew of a single-phase railway that will be shortly installed in Michigan, the details of which, however, he could not divulge owing to a pending patent. He added, however, that the current would be single-phase and collected at 1100 volts, and that the motors would not be stopped when the train pulled up.

YERKES IN LONDON.—Mr. Charles T. Yerkes has bought another London Railroad, or, rather, he has contracted for 999 years with the Great Northern Railway to take over its suburban business and the franchise for the projected underground road to extend from Holborn to Finsbury Park. Parliament will be asked to grant a franchise for a link, less than a mile long, to connect this line with Mr. Yerkes' Brompton and Piccadilly line. Both lines connect with the District (underground) Railway, giving to Mr. Yerkes control, altogether, of 46 miles of road.

CAPE NOME CABLE.—The possibility of maintaining an Alaska cable begins to appears open to doubt. A dispatch from Port Townsend, Wash., of Sept. 27, says: "The passengers returning on the steamer Oregon report that the cable between St. Michael and Cape Nome is a failure. In several places the ice has cut the cable. It has been ascertained that there are nine breaks. The gap was supplied with a new cable, but it has been so badly damaged as to be practically worthless. A surveying party has been in the field surveying a land route for a telegraph line.

ST. LOUIS EXPOSITION.—The letting of contracts aggregating about $11,000,000 for work on the buildings and grounds of the Louisiana Purchase Exposition will begin about Dec. 1. About $7,000,000 of this amount on the buildings and about $4,000,000 on the grounds. The letting will begin with four exhibit buildings, to cost about $4,000,000, and which will be larger than those of any previous exposition in Europe or America by over 25 per cent. The site includes the unfinished half of one of the largest public parks in the world—Forest Park. The part to be used contains 668 acres, and about 300 acres of surrounding property will be added.

WIRELESS TELEGRAPHY AT THE YACHT RACES.—The Associated Press is reporting the yacht races, now taking place off New York Harbor, by wireless telegraph. The steam yacht "Mindora" follows the yachts over the course and reporters aboard report the principal events of the contest to a shore station at Long Beach, L. I., whence the bulletins are forwarded to headquarters by telegraph or telephone. Barring some slight interference by another enterprise of the same character, the system works very successfully. The Associated Press is using the Marconi system pure and simple, an entire equipment and staff of operators having been sent over to this country by the Marconi Wireless Telegraph Company expressly to report the races.

AMERICAN PACIFIC CABLE.—President Roosevelt has, it is stated, ample power to grant the application of the Commercial Cable Company for permission to lay a cable which shall connect California, Hawaii and the Philippines. This will be the opinion, it is claimed, which officials of the Department of Justice will render upon the papers of the Commercial Cable Company now before them. These papers were referred to the Department by the Secretary of State. There are strong precedents for Presidential approval of the Commercial Cable Company's application. Before rendering an opinion upon the application of the Commercial Cable Company the Department is examining the laws to ascertain if there is any special legislation affecting Hawaii and the Philippines which will estop executive approval of the application.

DRYING WOOD BY ELECTRICITY IN AUSTRIA.—Consul Mahin, of Reichenberg, sends the following description of a new method of quickly preparing wood for building and manufacturing purposes, taken from a local technical journal: The green wood is placed in a large wooden trough, whose bottom is covered with a lead plate, which is connected with the positive pole of an electric battery. Covering the wood is a second lead plate, which forms the negative pole. The wood is then subjected to a bath in a solution composed of 10 per cent rosin and 75 per cent soda. Under the influence of the electric current, the sap is drawn out of the wood and rises to the surface, the solution being absorbed by the wood. The operation requires from five to eight hours. The wood is then allowed to dry for about two weeks, when it is ready for use; or the drying can be done artificially in a much shorter time.

KLONDIKE TELEGRAPH LINE FINISHED.—The officers of the Signal Corps of the army at Washington received information on Sept. 26 of the completion of the last link in the telegraph line between the United States and the Klondike regions. The link just finished is between Quesnelle and Atlin in Canada. The Signal Corps had constructed a line from Fort Egbert in the Yukon region southward, and were waiting for the Canadian authorities to finish the line between Quesnelle and Atlin, the completion of which opens communication through from the United States to Fort Egbert, at the head of the Yukon River. About 300 miles westward from Fort Egbert is Fort Gibbon, which is connected by telegraph with St. Michael. Work is to begin soon on a line connecting Fort Gibbon with St. Egbert, thus adding another link which will open up communication all the way round.

ELECTRO-DEPOSITED CATHODE PLATES.—An interesting observation regarding the physical state of electro-deposited copper, and an ingenious application thereof, are noted in a patent recently issued to Messrs. Elmer G. Elliott and Valentine Kishner, of Perth Amboy, N. J. The inventors find that copper deposited upon a cathode plate which has been grooved, or rather merely scratched with a sharp instrument as a knife blade, presents an apparently continuous surface, but that the electro-deposit above the scratch differs greatly from the rest of the plate in respect of tenacity, being, in fact, so loose and porous in texture that the copper sheet can be readily torn apart along lines originally defined only as scratches on the cathode. The patented application of this is to the manufacture of "starter-sheets" of copper for use in the electrolytic refining of that metal. A lead plate is scratched to define the shape of the desired sheet, suspended as cathode in an ordinary copper-plating bath and a layer of copper of suitable thickness, 1-32 of an inch, for example, is deposited. That portion of the deposited copper which lies within the limits of the scratched pattern may be readily stripped from the lead plate, leaving as a margin upon the latter an electro-deposited frame, which serves to stiffen and strengthen the plate for the next operation and is finally broken off when of such thickness as to interfere with the plating. The copper sheets so formed are employed as cathodes (starter-sheets) in the ordinary refining vats, forming bases for the deposited refined metal and being of even quality therewith. The scratch-grooves may be formed in the edges of the plate instead of in its face near the edges. In this case no margin remains after the deposit is stripped, and the plate must therefore be heavier and stiffer and is formed of copper. The first-mentioned procedure would seem to be preferable as providing a frame, heretofore usually constructed of wood, to guard against distortion of the sheet and as permitting the continued use, as cathodes for the starter-sheets, of the thin sheets of lead which have hitherto proven most satisfactory.

LETTER TO THE EDITORS.

Shaft Oscillation.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Sept. 28 I notice a description of a shaft oscillator by Mr. A. B. Weeks. This, in my estimation, is not quite sound engineering. In ordinary machines the commutators are only a little wider than the brushes. When the shaft performs its end play the brushes necessarily bear at certain portions all the time and only a part of the time at other places. This causes uneven wear on the commutator, and if the end play is not taken up, it will cause the brushes to jump and consequently spark. My experience with high-speed machines shows that they run much better from a sparking standpoint without end play. Staggering the brushes will tend to keep it more even. Direct-connected dynamos never show signs of any necessity for end play.

NEW YORK CITY. ALPHONSE A. ADLER.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS. MOTORS AND TRANSFORMERS

Slotted Armatures.—ZIEHL.—A communication in which he criticises the results recently obtained by Dick (Digest, Sept. 7), namely, that a dynamo is properly built if the air-gap is made a minimum and that the excitation required for a larger air-gap, can better be used for overcoming the reluctance of the highly saturated teeth, to obtain the best dimensions of teeth and slots. The present author doubts that this result is in general correct. He discusses briefly the advantages and disadvantages of slotted armatures. The advantage being a saving in exciting ampere turns, the disadvantages being hysteresis and eddy current losses in the teeth and more sparks at the commutator. He agrees that small machines and machines of medium size should be built with slotted armatures; while this is in general not the case with large machines. To place the armature windings in slots should always be considered a disadvantage, even if necessary, due to the lack of space between the surfaces of the poles and armature. He speaks in favor of as few slots as possible and of slots of small depth, to make the form of the armature similar to that of a non-slotted armature. He has sometimes found it advantageous to place a part of the armature windings directly on the surfaces of the armature and the other part in slots only about half as deep as the slots in a pure slotted armature. He concludes that a dynamo is properly designed, if for a given excitation or number of ampere turns, for a minimum air space, and for a maximum induction, in the air, and if necessary, high saturation of the teeth, the armature windings are so arranged that they are as near as possible to the circumference of the armature, i. e., that the armature approaches the form of a non-slotted armature as much as possible.—*Elek. Zeit.*, Aug. 22.

H. S. MEYER.—Another communication referring to the article of Dick. He doubts whether a very small air-gap is always to be recommended. For induction motors it is, of course, required, but it is there considered to be a disadvantage. A very small air-gap has considerable mechanical difficulties and disadvantages. He thinks that it is not right to limit the saturation of the teeth to 18,000 gauss (lines per square centimeter); he has found that the best results are obtained with saturations of the teeth of 22,000 to 24,000 gauss and an air space of about 1 to 2 mm. in small machines and up to 8 or 9 mm. for large machines. He gives a slightly more general modification of a formula of Dick.—*Elek. Zeit.*, Sept. 12.

Self-Starting Single-Phase Motor.—MICHEL.—A description, illustrated with diagrams, of an improvement of Hasselwander. In the short-circuited armature of this induction motor, the wires in which the currents are induced and those which produce the torque, are not connected together in parallel, as is usual, but through choking coils. One end of each coil is connected to a copper ring, while the other ends are connected to each other through choking coils. The impedance of these choking coils, which are placed on the rotor, is greatly increased when they arrive at a certain position, due to the presence there of a fixed inductor, and their throttling action therefore varies as they pass this inductor. The current from those coils in which it is induced, flows chiefly through the choking coils having the lower impedance, to those coils which produce the torque, and could be forced to flow in a certain direction. The connections must therefore be such that there are always at least two paths between the inducing coils and those producing the torque, one of these paths having a lower impedance than the other. Several modifications of the device are illustrated.—*Zeit. fuer Elek.*, April 7; abstracted briefly with some of the illustrations in *Science Abstracts*, Aug. 26.

Conversion of Single-Phase to Polyphase Plant.—E. K. SCOTT.—An article in which he discusses how much of a single-phase plant already in use may be converted for two or three-phase working. This question is of interest as the multiphase systems come into use more and more. Of alternators, those without iron in the armature, as the Ferranti, Brush and Siemens machines, cannot, under any circumstanves, be altered to two or three-phase, while with iron-clad alternators of the ordinary type the conversion is easy. Several ordinary types of transformers can be altered to three-phase working, but this is not possible with the shell type. While it is possible to have in a three-phase system a single-phase transformer in each phase, he thinks it is much more advantageous to use three-phase transformers. In the district of St. Etienne, in France, where silk ribbon is made by a large number of small manufacturers, each owning one or two looms, about 3000 small three-phase motors of about 1½ horse-power each, are in use for driving the looms. When the plant was first put down, three separate transformers were installed in each case for each phase, with the result that the switching on and off of motors upset the lighting very much. This was cured by the installation of three-phase transformers. Other points in favor of properly built three-phase transformers are that for a given output they are much cheaper and take up much less space than three separate transformers.—Lond. *Elec. Rev.*, Sept. 13.

REFERENCE.

Direct-Current Dynamos.—An illustrated description of large direct-current generators, made by the English Electric Man. Co., at Preston. The construction of the machines is described and the results of tests are given in two diagrams.—Lond. *Elec.*, Sept. 13.

LIGHTS AND LIGHTING.

Arc Between Conductors of the Second Class.—RASCH.—A reply to criticisms of a statement made by him some time ago that his new arc lamp (in which an arc is formed between electrodes of materials like clay or porcelain mixed with the rare earths, like those in the Nernst lamp) has a light efficiency of 100 per cent. He claims that the Tumlirz figure for the mechanical equivalent of light, is a very valuable unit of measurement and is strictly correct as far as it refers to present methods of illumination. He maintains that his former statement concerning the efficiency of his lamp is correct, but states that it refers to the physiological and not to an energy efficiency. He claims that the principle of the method has not been understood. In a foot note he adds that it is nonsense to state that a source of light of high efficiency should not radiate heat (but does not make it clear why this should not be so). He claims that the word "light" refers to a combined physiological and psychological effect, and that in measuring light, we measure the quantity of energy by means of such a physiological effect. Some figures of Langley showing the light effect for equal amounts of energy, for the different colors of the spectrum, are given, and from these he claims to show that when the so-called efficiency, that is, the relation of the light rays to the total rays, is limited, the number of candle-power may differ enormously; for instance, for yellow it would be 2800, while for green it would be 100,000. Concerning the consumption of the electrodes in his lamp, he states that it is quite slight, and that the arc burns about 15 minutes and sometimes 3 or 4 times that, without requiring feed-

ing of the carbons or without going out. The criticism of Nernst that the consumption of electrodes would be prohibitive is, therefore, not well founded.—*Elek. Zeit.*, April 25.

REFERENCE.

Templets for Lamp Bases.—An illustrated reprint of the regulations of the German Reichsanstalt regarding the examination of templets for the bases and sockets of incandescent lamps, according to the rules of the Association of German Elec. Eng.—*Elek. Zeit.*, Aug. 15.

POWER.

Electric Power in Shipyards.—ROBERTSON.—A Glasgow Internat. Eng. Congress paper on electric power supply in shipbuilding yards and marine engine works. The advantages of electric driving in marine engine works are, saving in cost of power, flexibility of the system due especially to the use of portable tools, and a substantial increase of output at a very considerable reduction of cost for labor. These advantages are still more enhanced in shipyards where flexibility of the system is of the highest importance. The tools themselves are, as a rule, of a heavy class which can most conveniently and economically be driven by independent motors, and may thus be disposed in such positions as to reduce to a minimum the handling of the raw material. Unless in the case of special portable tools, it is not economical to use motors of less than 5 horse-power. Where machines are worked intermittently and at varying powers, it is possible by suitable grouping to arrange a motor of, say, 10 or 20 horse-power upon a shaft to drive machines which, if supplied by separate motors, would require an aggregate of more than double that power. Single motors may be used in the shipyard to greater advantage, but the tools in this case are of such a class that in very few cases will smaller motors than 5 horse-power be required. When new engine shops and shipyards are built, it is undoubtedly the best policy to adopt electric power, and in most cases it will pay to make the change in existing plants.—Lond. *Eng'ing*, Sept. 13.

Power in Marine Engine Works.—CRIGHTON and RIDDELL.—An abstract of a Glasgow Internat. Eng. Congress paper on the "Power required to drive marine engine works and for electric lighting." They describe the improvements made in a plant at Glasgow which formerly had one marine type boiler at 80-lb. pressure, supplying steam to three vertical compound engines for driving the machinery and one vertical compound engine for lighting purposes. In the new plant only one engine is used for the whole plant. Two dynamos are laid down for lighting and power purposes. These and two lines of shafting are connected to the main engine shaft with belts. Motors are laid down to drive all outlying shafting. The power in such a plant is expended in removing material from rough castings and forgings. They found that the cost of this operation was reduced by 52 per cent under the new system.—Lond. *Elec., Elec. Rev.*, Sept. 13.

REFERENCES.

Elevators.—BAXTER.—A continuation of his illustrated article on electrically controlled hydraulic elevators. He describes the general arrangement for the electromagnetic control of hydraulic elevators, when the controlling current is obtained from a primary battery of moderate capacity or from a storage battery.—*Am. Mach.*, Sept. 19.

Alternating Currents in Mines.—WALKER.—An abstract of a Glasgow Internat. Eng. Congress paper on the advantages of alternating currents for use in mines. This system is specially suitable for high-pressure distribution from a center, and for use for driving machines underground, on account of the simple and compact construction of the induction motor.—*Eng'ing*, Sept. 13.

TRACTION.

Three-Phase High-Speed Traction.—In an editorial on the Glasgow Congress some critical remarks on Lasche's paper are made (see Lasche's article, ELECTRICAL WORLD AND ENGINEER, Sept. 14, 21, also Digest, Sept. 28). While this paper is highly recommended, it is regretted that the trials of the locomotive have thus far been carried out only with the locomotive mounted on rollers. Between the conditions thus established and the actual practical conditions when running on a track, there is a great gulf. Many of the most vital considerations affecting high-speed working are ignored in the former arrangement, such, for instance, as the effect of the momentum of the locomotive itself and of the train drawn by it, as well as the influence of curves and gradients. The subject of Lasche's paper must be divided into two distinct parts, which have no necessary relationship with one another, viz., use of high pressures, and the adoption of high speed. High pressures can be used on existing lines, and the question whether high-pressure alternating currents or continuous current of lower pressure are the better for railway traction under ordinary conditions, can as easily be settled on railways already constructed as upon specially built tracks. Such is not the case, however, with high speeds, e. g., 124 miles an hour. The curves and gradients of ordinarily built railways would render these speeds prohibitory. Even on a straight portion of ordinary railroad track, such speeds would almost certainly require radical differences in track construction and in the shape and size of the rail. The results of the trials on the road are therefore expected with the greatest interest.—Lond. *Elec.*, Sept. 13.

Destruction of Gas Pipes by Tramway Return Currents.—LEYBOLD.—A Glasgow Internat. Eng. Congress paper in which he gave an account of observations made in Hamburg, Germany. In a street, near the electric plant, the gas pipes were destroyed. On one side of the street is the main gas pipe of cast iron. Wrought iron service pipes cross the road to the lamps on the other side. In the middle of the road there are two lines of tramway rails, cars passing at intervals of three minutes, so that about every 1½ minutes a tram passes any particular spot. The rails are placed upon a bed of concrete 0.2 m. thick. The gas pipes are laid at right angles to the rails at a depth of from 0.55 m. to 1 m. The street is paved with granite well jointed with asphalt. Holes were found in all the wrought iron pipes, the position of the holes coinciding exactly with the position of the rails. The pipes are covered with canvas soaked in boiled tar. In many places blisters were found between the iron and the tar, which were filled up with a green solution of protochloride of iron, in some places also with crystals of the same salt. How this could be formed, is evident from the fact that the earth in the vicinity contains between 0.006 and 0.04 per cent of chloride of sodium. The danger to the pipes has been removed by providing a large number of insulated return transmissions for the tramways.—Lond. *Elec. Eng.*, Sept. 13.

Emergency Repair Wagon Service in Brooklyn.—The extent of the Brooklyn system requires the quick response of repair men in case of accident, and the company has recently built a number of emergency stations with the same facilities for rapidly harnessing horses and getting the men out, as are contained in the usual fire engine houses. One of these stations is illustrated. The ground floor provides space for at least two emergency and repair wagons, as well as a tower wagon. The second floor contains the living apartments for the crew, consisting of four men. The foreman, with his family, occupies the upper floor. The company is proposing to use steam automobile emergency wagons in place of those run by horses. It is thought they will be able to reach the scene of trouble quicker.—*St. R'y Jour.*, Sept. 7, and Int. Ed., Sept.

REFERENCE.

Berlin.—In a continuation of the serial on the recent visit of the Brit. Inst. Elec. Eng. to Germany, an illustrated description of the Berlin electrical elevated and subway railway is given.—Lond. *Elec.*, Sept. 13.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Central Station Statistics of Germany.—The very full, annual statistics, covering 23 full pages of tables, besides a long editorial summary of the public lighting stations, which existed on April 1, 1901. Private plants and pure traction plants are omitted. A new column is added this year, giving the capital investment, but this column is not complete, as only 318 of the existing 768 plants, have given the information. The capital invested in these 318 plants with together 137,508 kilowatts, is $55,939,120. It is estimated that the total capital invested in German central stations is $125,000,000. The number of central stations in 1901 is 768 against 652 in 1900. Several of the stations supply current to a number of towns—in one case 66—in a circular area with a radius of 9 to 12 miles; 81.3 per cent of all stations, against 80.4 per cent last year, use direct current, but their capacity is only 49 per cent of the total capacity of all plants, against 53.8 per cent last year. The reason is that the large number of small stations of less than 100 kilowatts generally use direct current, while the large stations generally supply three-phase or single-phase alternating currents to converter sub-stations. The number of combined three-phase direct-current plants is 43, with 86,985 kilowatts, against 38, with 41,757 kilowatts, last year. The number of combined single-phase, direct-current stations is 10, with 6874 kilowatts, against 6 with 1599 kilowatts, last year. The number of pure three-phase plants is 45, with 41,634 kilowatts, against 39, with 35,677 kilowatts. The number of pure single-phase or two-phase plants is 44, with 27,-

548 kilowatts, against 42, with 21,572 kilowatts. Two plants of together 950 kilowatts use the monocyclic system. In nearly all direct-current stations storage batteries are used. The total capacity of storage batteries in the direct-current plants provided with them is 32.6 per cent of the capacity of the dynamos. In 60.3 per cent of all stations the generators are steam driven. Water power is used in Rheinfelden with 12,360 kilowatts and in 72 smaller stations of together 3354 kilowatts. In 170 plants, with together 36,000 kilowatts, both steam and water power are used, the steam being generally the reserve. Gas machines for driving the generators are used in 39 stations, i. e., 5 per cent of all stations, but they have together only a capacity of 1.1 per cent of that of all the stations. There are in Germany 38 plants—against 23 last year—with a capacity of more than 2000 kilowatts. The largest station is the Oberspree station of Berlin, the generating plant alone having 10,770 kilowatts, and with the sub-stations 22,075 kilowatts. The capacity of all lamps and motors connected to all plants is 329,572 kilowatts, while the capacity of all stations is 352,570 kilowatts, against 230,058 kilowatts last year. Electric motors represent 38.6 per cent of the total connections. In Prussia alone 99,352 electromotors were connected to the stations; 126,965 electric meters are used in stations.—*Elek. Zeit.*, Sept. 5.

REFERENCE.

Switch Gears.—WARRILOW.—The conclusion of his article on the design of switch gear. In this part he deals with direct-current switchboards controlling low pressures and carrying heavy currents.—Lond. *Elec. Rev.*, Sept. 13.

ELECTRO-PHYSICS AND MAGNETISM.

Transmission of Electric Waves Through Liquids.—NORDMAN.—An account of experiments in which he investigated how far Hertzian waves penetrate a conducting liquid. He experimented with sulphuric acid, sodium and potassium chlorides, and magnesium sulphate solutions. The maximum thicknesses traversed by the waves in the four liquids were 5 mm., 18 mm., 32 mm. and 41 mm., respectively. The general result is that transparency to Hertzian waves varies in the same sense as resistance, but not quite so rapidly.—*Comptes Rendus*, Aug. 5; abstracted in Lond. *Elec.*, Sept. 13.

REFERENCE.

Disruptive Discharge in Electrolytes.—JOHNSON.—An account of experiments in which he confirmed the result, found by Broca and Turchini, that a disruptive discharge may take place in an electrolyte in very much the same way as it does in a dielectric.—*Comptes Rendus*, Aug. 5; abstracted in Lond. *Elec.*, Sept. 13.

ELECTRO-CHEMISTRY AND BATTERIES.

Edison Storage Battery.—BAINVILLE.—An article on the new Edison nickel-iron battery. He gives a review of Kennelly's paper. He thinks it is still too early to express an opinion regarding the practrical value of the battery, but he makes the following critical remarks Kennelly's data as to the capacity of the lead accumulator are too unfavorable to the same and the capacity per weight of the new Edison cell, as given by Kennelly, is therefore not better than good light traction lead cells. He claims that in the Edison cell the electrolyte is difficult to handle and must be protected against air. The e. m. f. of discharge of the Edison cell is much less constant than in the lead cell. He does not believe that only a small quantity of electrolyte is required. He says that the quantity and volume of the electrolyte cannot remain constant during discharge on account of evaporation and for the reason that "the oxygen and hydrogen are necessarily furnished by the electrolytic decomposition of water"; (this is evidently wrong; if he makes the somewhat old-fashioned assumption that during the discharge of the Edison cell oxygen is set free at the iron electrode and hydrogen at the nickel hyperoxyde electrode, so that at the former iron oxyde is formed and at the latter the nickel hyperoxyde electrode is reduced and water is formed, it is evident that for any molecule of water which is decomposed to give oxygen and hydrogen, another molecule of water is formed at the nickel plate, hence the total quantity and the concentration of electrolyte are not changed.) He claims it will be difficult in practice to find an easy method for determining the moment when the charge is completed. He thinks the Edison cell will not compete with stationary lead cells, but that its field may be for automobile.—*L'Elec.*, Aug. 31.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Induction Meter.—SCHROTTKE.—A very long, profusely illustrated paper read before the Electrotechnical Society, of Berlin, in which he describes an induction meter of Siemens & Halske. The general arrangement is shown in the adjoining diagram. *A* is a ring, formed of thin sheets of iron, with four pole pieces *E E* and *F F*. Inside there is a laminated iron core *C* around which there is placed a very light drum *B* of aluminum, which is movable around the axle *D*. The winding of the pole pieces *F F* consists of a few thick turns, that of the pole pieces *E E* of many thin turns, the former is the current coil, the latter the voltage coil. If the current in the former is *I* and in the latter *i*, the torque produced upon the aluminum drum is pro-

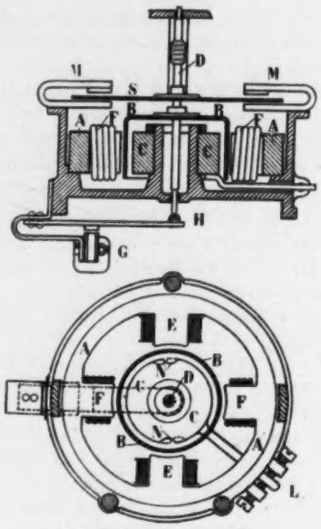


FIG. 1.—INDUCTION METER.

portional to the product of *I* and *i* and the sine of the phase difference between them. This shows the difference between induction meters and dynamometric meters, as in the latter the torque is proportional to the cosine instead of the sine. He therefore proposes to distinguish both groups as sine and cosine instruments, respectively. What is wanted, is the measurement of the energy, i. e., the product of the current, e. m. f. and the cosine of the phase difference between them. When an induction meter is used, it is therefore necessary to use a device by which the current in the voltage coil of the meter is out of phase by 90 degs. against the e. m. f. producing it. This device is a bridge arrangement, shown in the adjoining diagram where *R R D* are non-inductive resistances and *S S* the voltage coils of the meter. An induction coil, *Drsp*, is in series with this arrangement as shown in the figure. He shows that the current in the voltage coils *SS* is in quadrature with the e. m. f. between the terminals P_1 and P_2. The device is very simple and practical, as it can be easily adjusted by varying the diagonal resistance *D*, and the sensitiveness can be easily changed by varying the resistances *R* and *R*. The energy consumed in the voltage coils in meters for 120 volts is about a watt. He says that it would not be practical to try to lower this energy consumption. The magnetic brake is shown in the first figure, where

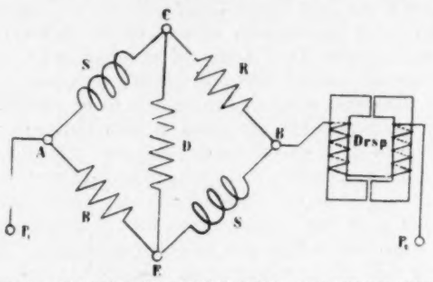


FIG. 2.—DIAGRAM OF CONNECTIONS, INDUCTION METER.

S is an aluminum disk running between the poles of strong permanent steel magnets *MM*. The friction of the bearing is compensated by a simple device, the iron core *C* being provided with two small slots *N*, shown in the figure just opposite the voltage coils *EE*. The iron core *C* can be turned by means of the screw device *L*. When the iron core is slightly turned so that the two slots are in the position shown by dotted lines, then there is a slight dissymetry of the field of the voltage coils, which produces the desired compensation. In order to prevent the meter from running at no load, the following simple device is used. The lower rim of the movable drum *B* has

some nicks, generally four. The resistance of the drum in one direction is therefore slightly different from that in another perpendicularly to it. The drum takes a position before the poles with the voltage coils so that the current produced in it is a minimum. It can then be turned to one or the other side only by applying a certain force. To make the meter indifferent to external vibrations, the total movable system of the meter (the aluminum drum and its accessories) is kept continually in very quick artificial vibration, by means of the small electromagnet *G*, the armature of which makes the spring *H* rotate, which holds the agate bearing. The friction of the bearings is thus reduced to one-tenth. The weight of the total movable system is only 27 grams. The meter is said to stand long overloads up to 30 per cent and short ones up to 100 per cent. It has also been found to stand short circuits well. He then makes some theoretical remarks about induction meters. Frequency and wave form have only a small influence. It is of great advantage to use iron in the meter. Many other details and accessories are described.—*Elek. Zeit.*, Aug. 15.

Registering Instruments.—HOSPITALIER.—With the usual form of registering instruments, in which the needle carrying a pen or pencil at its movable end registers on a cylindrical drum, the lines are curved to the short radius represented by the length of the needle, and this curvature is often inconveniently great. To overcome this, and to make the curves approximately straight lines, he suggests securing a fork to the end of this needle in place of the pen, and placing the movable end of a very long lever between the prongs of this fork, the registering pen being carried at this end of the lever while the other end is pivoted. The curves thus drawn will have the radius of the long needle, and can therefore be made as nearly a straight line as desired, the needle of the measuring instrument being made as short as desired. The arrangement is applied in his new ondograph recently described in the Digest, but is applicable also to other forms of instruments.—*L'Ind. Elec.*, July 10; *L'Eclairage Elec.*, July 13.

A Physiological Photometer.—STANOIEVITCH.—A description of a new and very simple photometer, based upon the fact that a certain quantity of luminous energy is required to produce a visual impression upon the retina. Thus a triangular or circular patch, to be distinctly visible, requires a certain constant minimum illumination which differs with different eyes and with different conditions of the same eye, but is, on the whole, constant within, say, 10 per cent. His photometer has the form of a small telescope, 10 inches long and 2 inches in diameter. At one end is a piece of ground glass which is turned towards the source. Some 4 cm. behind it is fixed an iris diaphragm, whose aperture is at the principal focus of a convex lens. The latter produces a parallel beam of rays which illuminates another diaphragm, and the latter is again observed through another lens. In using the instrument, the iris diaphragm is screwed down until nothing is seen, and then gradually opened until the round aperture is clearly defined. The instrument is calibrated empirically. A number of luminosity determinations may be made in the streets in a single evening. But care must be taken to have the eye in the same state of fatigue. (This appears to be practically a reinvention of the Houston & Kennelly illuminometer.)—*Comptes Rendus*, Aug. 5; abstracted in Lond. *Elec.*, Sept. 6.

Localizing a Fault in a Single Cable.—RAYMOND-BARKER.—An illustrated article on the method, devised by Betts, for localizing a fault in a single cable. In this method equal batteries, zinc to line, are simultaneously applied, through suitable galvanometers, to the two ends of the cable in which the fault is to be localized. At set times synchronous readings are noted at both testing stations, and, by comparison with a galvanometer constant obtained through a standard resistance, these readings are reduced to corresponding resistance values. Although these resistances vary according to changes at the fault, each simultaneous pair of resistances obtained at the two ends of the line, are strictly comparable. The present author shows that this method is well adapted to graphical illustration.—Lond. *Elec. Rev.*, Sept. 13.

TELEGRAPHY. TELEPHONY AND SIGNALS.

REFERENCES.

Railway Signals.—TIMMIS.—A long abstract of a Glasgow Eng. Congress paper on modern practice in railway signaling. Only pneumatic and electric signals are practical. Among the pneumatic, he described the Westinghouse high-pressure and the low-pressure systems. Among the electric systems he mentioned that used in the United States, and described the automatic one used on the Liverpool Overhead Railway, the non-automatic system which is being installed at Crewe, and a third system which embraces a track circuit.—Lond. *Elec., Eng'ing*, Sept. 18.

Wireless Telegraphy.—COLLINS.—An illustrated article in which he describes the construction of an efficient wireless telegraph apparatus at small cost.—*Sc. Amer.*, Sept. 14.

Progress in Telegraphy and Telephony.—A summary, mostly from patent specifications, of new inventions and improvements made in telegraphy and telephony during April, May and June.—*Elek. Anz.*, Aug. 15, 18.

Fire Alarm—OHL.—A well illustrated description of the fire alarm system in the city of Hanau, Germany.—*Elek. Anz.*, Aug. 8.

MISCELLANEOUS.

Visit of the British Institution of Electrical Engineers to Germany.—E. KILBURN SCOTT.—An account of this visit which has already been mentioned repeatedly in the Digest. It included Hanover, Berlin, Dresden, Nuremberg and Frankfort, and was a great success. He attributes much of the great electrical progress made in Germany to suitable political conditions. The Emperor takes a great interest in every branch of science, but particularly in electricity. In Germany there are about 70,000 persons engaged in the manufacture of electrical apparatus alone, and one company employs about 17,000 persons. He then describes three electric railways inspected in Berlin. First, the Wannsee Railway operates trains composed of ten ordinary cars like those used on the Prussian State railways, the first and the last being fitted with motors. Each of these cars has three driven axles, the weight of the empty trains is 193 tons, the motors of both cars are controlled by one controller. The second road inspected was the Gross Lichterfeldt trial road, put in operation in 1899, and using three-phase current at 10,000 volts. (Reichel, ELECTRICAL WORLD AND ENGINEER, Sept. 7.) The elevated and underground road is about 7 miles long, and runs practically east and west through the central portion of Berlin. Direct current is used at 750 volts. The power station is practically completed and contains three 800-kw units. He then considers the workmen and staff of the German factories, and finds that, while the men are not paid such high wages as in Great Britain, great consideration is shown them by the manufacturers, and the appointments of the factories are most modern. Most of the work is done in piece work. A feature of the work is the orderliness to be found everywhere, which is undoubtedly due to the military training which the men have received in the army. Many of the electrical companies have branch factories in various countries, and this gives them a great advantage, not only because they are better able to judge of local requirements when a contract is awarded from a foreign country, but also because they can temporarily transfer the manufacture of apparatus from one of the works to another. He then discusses the financial situation in Germany. Much of the present condition he attributes to speculation by banks. The German law is, however, very strict with those who misuse public funds and the managers of banks that have failed are duly prosecuted. The banks are more closely associated with the manufacturing companies than in Great Britain or America—*St. R'y Jour.*, Sept. 17, and Int. Ed., Sept. ·

Glasgow Exhibition.—SAYER.—An abstract of a Glasgow Internat. Eng. Congress paper in which he discussed some of the chief objects of interest to electrical engineers in the Glasgow exhibition. The conductors for the arc lights are of aluminum. The British Schuckert Company has exhibited a transforming plant, for 500 volts direct current to 10,000 volts three-phase, by means of synchronous converters and transformers. The three 10,000-volt circuits are interrupted by a Schuckert high-tension switch, when about 5 amperes is flowing in each circuit, 5 amperes representing about 100 kilowatts. Each switch unit consists of two terminals, each in the form of a wire frame, mounted so as to be in the same vertical plane. At the lower side the frames are about 3 inches apart, but the rising wires diverge from each other at an increasing rate. The circuit is opened by a switch blade at the bottom of the frames, and the arc which is established is carried upwards between the diverging wires by the air-current and so stretched out until it breaks. He also referred to an electric tram car exhibited by the Brit. Westinghouse Company and fitted with the Newall track brake. In this brake the magnets in pulling towards the rails, also pull the shoe brake on to the wheel, thus increasing the adhesion at the same time the brake is applied. The brake is operated by the car motors run as generators. —Lond. *Elec.*, Sept. 13.

Magnetic Separator.—A well illustrated detailed description of the Waring system of magnetic concentration. This system can be characterized as a combination of two older types, one being the drum type with magnetic fields created in peculiarly formed grooves, extending annularly around the drum, the other having magnets which oscillate from side to side directly across a flowing stream of material. The Waring system of magnetic concentration and classification is in use at Webb City, Mo., for the purification of zinc blende ores, the extraction of blende from pyritic jig stuff and for the experimental separation of pure zinc, copper and iron material from complex sulphide ores. The system is said to be very successful in practice. The method of treatment of the ores is described. The economy of the process is pointed out.—*Eng. and Min. Jour.*, Sept. 14.

Capacity of the Human Body.—DE METZ.—An account of experiments in which he measured the capacities of several persons under all sorts of conditions, and found that they were the same when the subject was nude and when dressed in close-fitting conducting material, and that, generally speaking, the capacity of a human body is the same as that of a metallic body of the same dimensions. The capacity remains the same for any charge between 100 and 1000 volts, but differs for different persons in accordance with the volume and shape of the figure. It changes rapidly when the person is surrounded by metallic surfaces, and also greatly depends upon the pose. The normal value for an erect person in the center of a hall is 0.00011 microfarad, for an individual of average stature. This is much less than the value found by other investigators. Bordier has placed the capacity of a human body at 0.0025 microfarad, and Dubois at 0.1650 microfarad.—*Comptes Rendus*, Aug. 5; abstracted in Lond. *Elec.*, Sept. 13.

Magnetic Properties of Human Blood.—GAMGEE.—Faraday found that blood, although containing a large proportion of iron, was diamagnetic. Pluecker showed that the blood corpuscles are more strongly diamagnetic than the liquid in which they flow. The present author has examined the magnetic properties of the crystalline blood-coloring matter, in the condition of utmost available purity. He comes to the conclusion that the blood coloring matter, oxyhaemoglobin, as well as carbonic-oxide haemoglobin and methaemoglobin are decidedly diamagnetic, while the iron containing derivatives haematin and actlaemin are powerfully magnetic. A preliminary study of the electrolysis of oxy-haemoglobin and carbonic-oxide haemoglobin renders it probable that, in the blood coloring matter, the iron containing group on which its physiological properties depend, is an electronegative radical. According to analogy, the iron in such a compound would possess diamagnetic and not paramagnetic properties.—Communicated to the *Brit. Royal Soc.*, June 20; abstracted in Lond. *Elec.*, Sept. 13.

International Engineering Congress at Glasgow.—An editorial on this congress, which is said to have been a striking success. The hope is expressed that it will be found practicable for the leading engineering institutions of Great Britain to unite in arranging for similar conferences to be held regularly, at intervals of a few years. The value of such a congress to engineers is discussed. Some notes are added on the papers on electrical subjects. (All these papers as far as published have been abstracted or referred to in other columns of the Digest.)—Lond. *Elec.*, Sept. 13.

New Books.

MECHANICAL DRAWING. Written for the use of the Naval Cadets at the United States Naval Academy. By Lieutenant-Commander F. W. Bartlett, U. S. N. New York: John Wiley & Sons. 188 pages, 132 illustrations. Price, $3.

This, as stated in the title, is written for the use of naval cadets at the United States Naval Academy, and is an epitome of the methods there used. The author states he has endeavored to eliminate any personal peculiarity of method and to base the treatise on the methods in use in the drafting offices of the United States Navy. The book very properly confines itself strictly to the mechanical part of mechanical drawing, if such an expression may be permitted. That is, it makes no attempt to go into the geometrical theories upon which mechanical drawing is based, but deals rather with the detail methods in the actual drawing operations. In this respect each point is covered very fully and with exact detail. The proper use of instruments is specified in great detail, as well as all the particulars of making a working drawing, from stretching the paper on the drawing board to the standard hatching for different materials. The whole book is a testimony to the thoroughness with which United States Naval Cadets are instructed, and though the work is evidently merely an instructor's compilation as distinguished from an authoritative treatise, yet many a draughtsman who thinks himself well qualified will find in its pages many hints of value.

ORIGINAL PAPERS BY THE LATE JOHN HOPKINSON, D. Sc., F. R. S. Edited, with a Memoir, by B. Hopkinson, B. Sc. Two volumes. Vol. I., Technical Papers. Vol. II., Scientific Papers. Cambridge: University Press. Vol. I., 294 pages; Vol. II., 393 pages. Price, $7.

These volumes form a worthy and interesting tribute to a man of great originality and power. He was singularly gifted with both physical and intellectual vigor, winning boat races, foot races and mathematical prizes. John Hopkinson was essentially both a mathematician and a practitioner. For him pure mathematics had but few attractions. The papers which are printed in these volumes show how practical was the bent of his mind, and how repeatedly he threw the results of his logical deductions into arithmetical and utilitarian form.

The papers printed commence with one bearing date of 1874 on "Group Flashing Lights," in connection with lighthouse work. They number 52 in all and terminate with a paper on "Alternating-Current Electrolysis," read before the Royal Society in November, 1893. Although we question the judgment with which these papers have been divided into technical and scientific, and believe that the best presentation of them would have been simply in their order of date, yet taken in any order they represent a copious and valuable addition to applied physical science. The papers will be valuable for purposes of reference.

The Memoir with which the first volume commences is interesting, as giving glimpses of the private life of this very gifted man. Unfortunately, it tells nothing of the tragic circumstances under which he met his death among the Swiss Alps in August, 1898. No library of electricity or applied physics can be complete without these volumes.

In addition to the scientific papers here reprinted, a separate chapter might well have been contributed upon his inventions and practical achievements. He was an independent inventor of the three-wire system, which was invented about the same time in this country by Edison. He also invented the series-parallel control and operation of direct-current motors, and reinvented the synchronous operation of alternating-current motors. The only serious criticism that we have to find with these memorial volumes is that they do not pour out the full worth and measure of John Hopkinson's meed.

PRACTICAL ELECTRIC RAILWAY HAND BOOK.—By Albert B. Herrick. New York: Street Railway Publishing Company. 407 pages, 344 illustrations. Price, $3.

This book can be aptly described as the Haswell of the electric railway engineer, containing as it does a large volume of useful information on almost every subject with which he desires to become familiar. The book is essentially a reference book and no attempt has been made to adapt it for continuous reading, though an effort has been made to classify and group like data together. The descriptions are of the briefest and most concise character, and although tests and technical work identical with electric railway engineering is given large space, matters of practical interest are predominant and much mathematical and theoretical data of scientific interest only has therefore been omitted. The book is intended to cover matters of practical value incidental to design, construction and operation of electric railways from the design of the power house to the rail return. It is therefore replete with steam and electrical engineering tests, and civil engineering is representd so far as it pertains to electric railway construction. Not the least feature of value of the book is the discussion of American apparatus and materials. It gives an immense amount of data concerning them which could otherwise only be obtained by extensive correspondence with the manufacturers and accompanying tedious delay.

As the object is to compress a large amount of information in a small number of pages, descriptions wherever necessary are most brief, and where possible the results of tests or computations are given in the form of tables or curves. The diagrams are very clear,

and where they refer to illustrations of standard apparatus they are dimensioned.

The book is divided into nine sections and two appendices, an enumeration of which will assist in giving an idea of its scope: 1. General tables. 2. Tests. 3. The track. 4. The power station. 5. Line. 6. Car house. 7. Repair shop. 8. Equipment. 9. Operation. Appendix: 1. Storage battery and boosters. 2. Underground conduit.

Heretofore the recourse of the electrical railway engineer for such information as this book contains has been an intimate knowledge with an up-to-date set of trade catalogues, a knowledge of the whereabouts of mathematical tables and formulæ and their use, reference to electrical and mechanical text books of engineering procedure, an extensive acquaintance with the material market, and his own note book.

The above information concentrated in convenient form has long been sought after, and it fills a much-needed want. The book contains much of Mr. Herrick's original work, and the results of his 20 years' experience, and much interesting data on subjects which he has made his specialties, among which may be mentioned the inspection and testing of equipments, feeder systems and ground returns.

The railway engineer will find this book more useful on his desk than in his bookcase, for even though he have at hand all of the data which it includes, the time saved in search for references is a consideration well worth the value of the volume. A book of this character requires to be thoroughly cross-indexed, and nine pages of fine print are devoted to this purpose.

BOOKS RECEIVED.

Mill Building Construction. By H. G. Tyrrell. New York: The Engineering News Publishing Company. 40 pages, 36 illustrations. Price, $1.

The Construction of a Gasoline Motor Vehicle. By C. C. Bramwell. New York: Emil Grossman & Brother. 149 pages, 86 illustrations.

Practical Hints on Joint Wiping. For Beginners in Plumbing. David Williams Company, New York: 66 pages, 41 illustrations. Price, 25 cents.

Pocket Book of Electrical Engineering Formulæ. By W. Geipel and M. Hamilton Kilfour. New and enlarged edition. New York: D. Van Nostrand Company. 829 pages, illustrated. Price, $3.

Parallel Tables of Logarithims and Squares. Feet, Inches and Fractions of a Foot Expressed in Decimals of a Foot and Advancing by 1-32 of an Inch. By Constantine Smoley, C. E. Cleveland, Ohio: Constantine Smoley. 212 pages. Price, $3.

Compound Engine Controller.

By Ralph J. Patterson.

When the fly-ball governors now in use are overworked their uncertain control of the cut-off of the low-pressure cylinders, especially in engines of the Corliss type, calls for an improvement which will enable engines to respond to the demands of their loads the moment they are called upon, and securing for them the best regulation and highest efficiency under rapidly fluctuating loads of railway and general power plants.

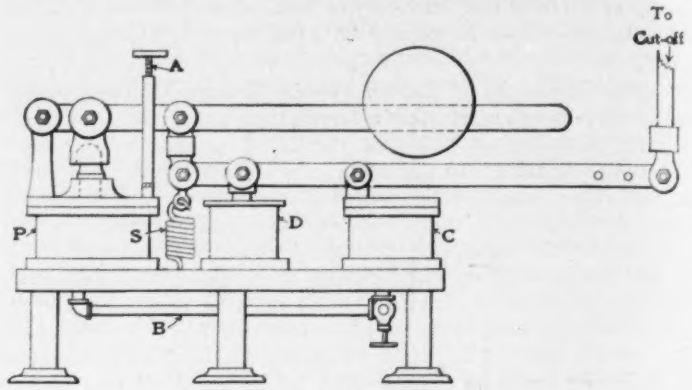
The Corliss engine, or, speaking more broadly, the engines with releasing valve-gear, have for a long time, and do now, hold the record of the highest efficiency of any type of engine. Improved methods of manufacture and closeness of regulation which can be obtained with fairly steady loads, together with economy of running, have caused many users and purchasers of engines to have a preference for this kind. As the compound Corliss type is the most economical engine to use, it is desirable to employ it for electric lighting and power, but upon its application to these uses, it was found that the regulation was not satisfactory, and this together with the fact that high speed was considered advantageous, gave an opportunity for other types of engines to encroach upon the field.

The compound engine controller, illustrated herewith, assures the closest regulation and increases the economy. It controls the cut-off on the low-pressure cylinder, without burdening the fly-ball governor usually put on these engines, and the distribution of steam in each cylinder can be made proportional to its size and share of the load. It enables Corliss engine builders to increase the speed and power of their engines, and use cheaper, lighter and more sensitive governors. Only slightly less in importance is the feature of control of the receiver pressure, maintaining it constant under varying loads, and for use in mills, factories, etc., where steam is utilized for heating vats, buildings, etc.

Somewhere between the condition which enables us to use all the exhaust for heating, and the conditions where it is needed only intermittently, or partially, the compound engine with condenser, will be found most desirable. In the latter case by the use of the controller to which this relates, the receiver pressure will be maintained constant without attention from the engineer, and whether there is much or little steam drawn from the receiver for heating purposes. The economy of using steam in this way is very apparent. The method of accomplishing this is not so simple as appears at first sight.

In the apparatus illustrated, *C* is a condensing chamber, to which a pipe from the receiver of the engine connects at the top. *P* is a piston chamber, and contains a movable piston which operates the levers, the movement of which varies with the tendency of the receiver pressure to raise or lower, and rests on water from the condensing chamber through pipe *B*, seen underneath the platform. The dashpot *D* prevents the vibration of the levers, due to the "kick" of the cut-off mechanism.

In operation the tendency of the pressure in the receiver to increase causes the piston to rise in its chamber, moving the upper or weight lever, and this in turn pulls the outer end of the lower lever down whenever the cut-off lengthens on the high-pressure cylinder



COMPOUND ENGINE CONTROLLER.

or the heating outlets are suddenly closed, thus lengthening the cut-off of the low-pressure cylinder and keeping the receiver pressure uniform.

It is thus seen that the cut-off on the low-pressure follows the cut-off on the high pressure at once, aiding very materially in controlling the speed of the engine. This operation is reversed in case the cut-off on the high pressure shortens or the heating outlets are opened.

The adjusting screw *A* is made to prevent the lever from operating too far, so the cut-off will not work. The spring *S* is made so that it will compensate for the inertia of the weights and also gives a quicker return of levers when the weight is falling. There is an air vent, not shown, which prevents air from collecting under the piston *P*, where it would form a kind of a buffer.

These controllers are in operation in several plants in Massachusetts and Georgia, and give excellent satisfaction, so much so that it has been deemed advisable to give others a chance to test their merits for themselves. They are manufactured by the Patterson Engine Controller Company, 43 Milk Street, Boston, Mass.

The Lincoln Synchronizer.

The accompanying illustrations show the Lincoln synchronizer, which furnished the subject of a paper read at the recent Buffalo meeting of the American Institute of Electrical Engineers, and the principles of which were given in the report of the meeting which appeared in these columns.

Placed conspicuously, the synchronizer may be turned about to any desired position, where the governor attendant and electrician can see its movements plainly, and note by the needle whether the alternator being started is running too slow or too fast. Synchronism is denoted by the upper vertical position of the needle. When revolving to the right, the dial indicates that the speed is too fast; to the left, that it is too slow. The alternator is speeded accordingly.

This synchronizer has been used in paralleling the 5000-hp alternators at the Niagara Falls Power Company's plant, where it has given the most gratifying results. Speed in synchronizing from a

FIG. 1.—LINCOLN SYNCHRONIZER.

shut-down, when it is necessary to get the plant in operation as soon as possible, is of the greatest importance, and demands promptness and accuracy. With it five dynamos have been put in parallel in as many minutes, including some interruptions due to telephoning, giving instructions to assistant electrician, etc.

In the accompanying diagram of wiring and connections, *a* are voltmeter transformers on the dynamos and *b* are similar trans-

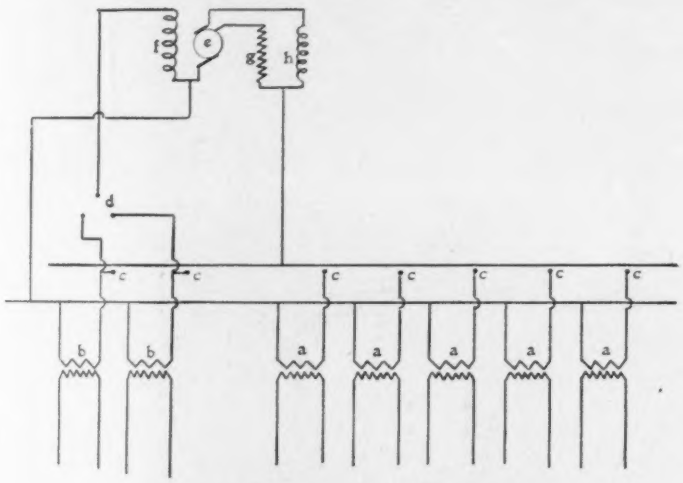
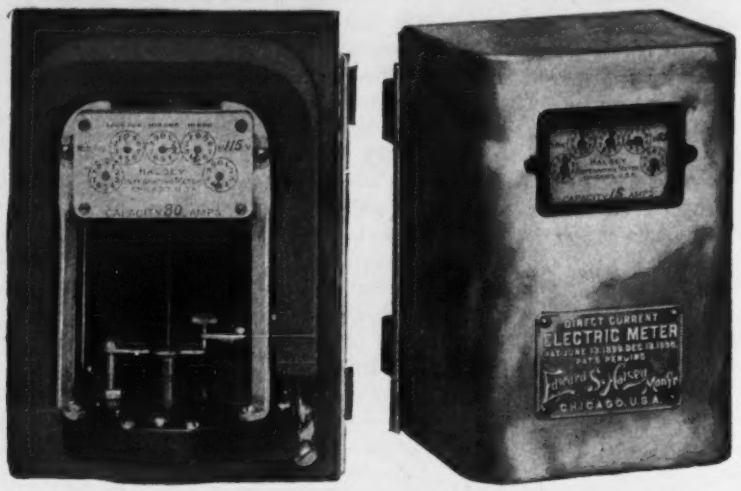


FIG. 2.—SYNCHRONIZER CONNECTIONS.

formers on the bus-bars; *c* are plug switches, *d* a two-point switch; *e* is the synchronizer armature and *f* the synchronizer field; *g* and *h* are respectively the ohmic and inductive resistances whereby a difference of phase is maintained.

Halsey Direct-Current Meter.

In our issue of Aug. 10 last was described and illustrated a new type of direct-current meter on which patents had been issued to Mr. Edward S. Halsey, of Chicago. The illustrations accompanying the article showed various forms of the meter, the principal features of which, as there summarized, being great accuracy, especially on light loads; absence of commutator, brushes and jewels, the armature being supported by mercury floatation; no deterioration of the strength of the magnets by short circuits; absence of coils; ability to stand large overloads, and an absence of continuous pressure shunt losses.



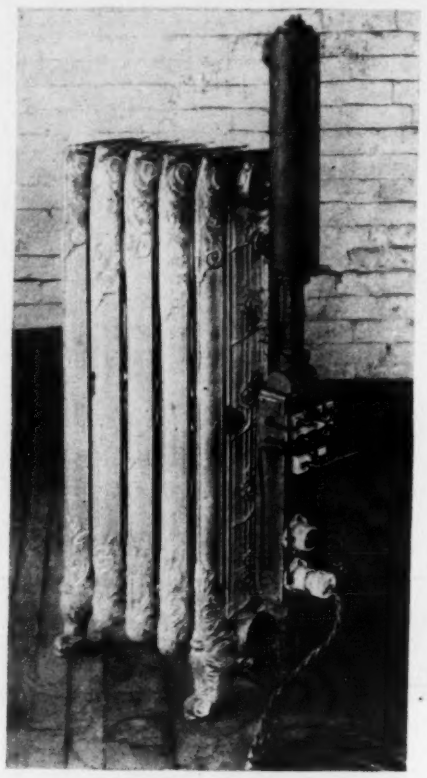
FIGS. 1 AND 2.—DIRECT CURRENT METER.

Starting from the basic principles as laid down in the patent specifications Mr. Halsey has now developed a commercial form of the instrument, which is illustrated herewith, Fig. 1 showing a meter with its enclosing case removed, and Fig. 2 a similar instrument with aluminum case. The illustration (Fig. 1) represents the instrument ready for shipment, the armature and the mercury opening being locked for the purpose.

This type of meter is made in sizes of 15, 30, 60 and 100 amperes, and calibrated to read in watt-hours on any constant-potential circuit from 100 to 240 volts, or in ampere-hours for arc lights and storage battery work. It is now ready for the market.

Electric Water Heater.

A patent has been issued to Waldo F. Follett, of New Haven, Conn., on an electric water heater which, it is claimed, will largely



ELECTRIC WATER HEATER.

reduce the cost of street car heating. The specific claims made in this connection are that in the case of a car from 14 to 16 ft. long,

in which ordinary electric heaters would take from 6 to 8 amperes, a car of the same length equipped with the electric hot water system would require only from 5 to 7 amperes. In still larger cars now requiring 20 or more amperes it is claimed that a saving of nearly 45 per cent could be made with the new system. Among the advantages claimed for the system is that the water absorbing the heat also acts as a cooling agent to the resistance wire, thereby permitting the use of a smaller wire than is used in the ordinary electric heater.

The heater consists of a casting which forms the flues and connecting heads and around which is wound the high-resistance wire, which is held by lava insulators and imbedded in insulating cement. The ends of the casting are made to receive iron plates fastened by screws, thus forming a casing which protects the resistance wire from injury. The accompanying illustration shows a hot-water radiator equipped with an electric water heater and an expansion tank, thus forming a portable heater. It has 34½ square ft. of heating surface, and contains 6 gallons of water. It is stated that this heater requires 800 watts to operate it.

Telpherage Ash Handling at Elizabethport, N. J.

Great progress is being made in telpherage, or the electrical transportation of material, as exemplified again in a plant which has recently been put in operation at the well-known works of the Singer Sewing Machine Company at Elizabethport, N. J. The work performed is the carrying of ashes from the boilers to a chute and there automatically dumping the same and returning to the starting point, or any place along the line of the boilers as may be desired. The load carried, including the bucket, is about 600 lbs. The lift is about 30 ft. The work is controlled by a switchboard located at a convenient place and is completely under the control of the man who is handling the ashes.

The telpher is of the side-bearing type, and is without any gear-

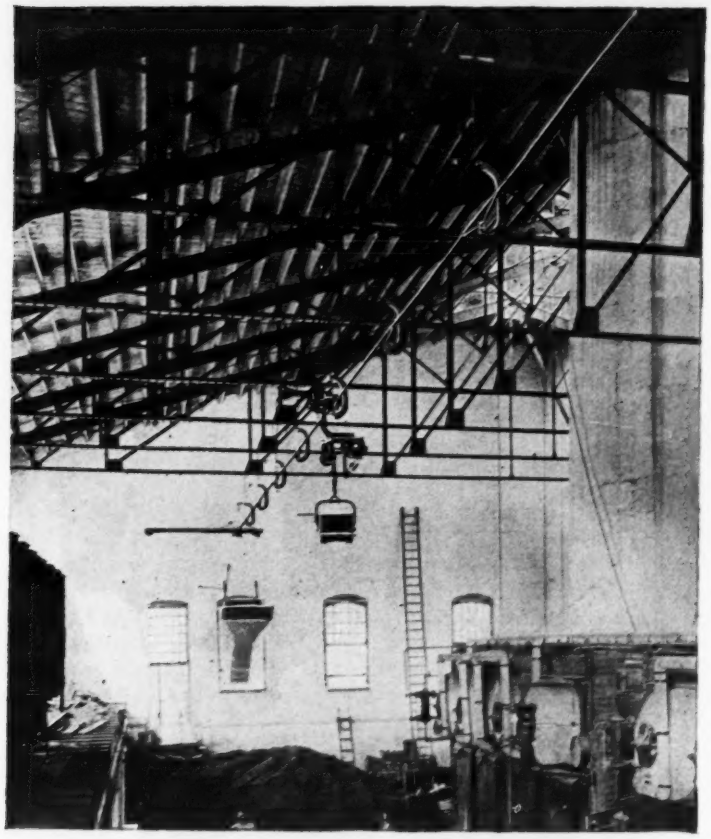


FIG. 1.—TELPHERAGE PLANT.

ing or transmitting device between the motor and driving wheel. The driving wheel is placed upon the shaft of the armature, thereby avoiding all wear and tear of gears or noise. The telpher has also a solenoid brake which acts automatically, gradually slowing the telpher down at any desired place. The telpher is under perfect control and can be moved a few inches or the total length of the line if so desired.

Below the telpher, as shown in the illustrations herewith, is an electric hoist. It will be noticed what a long lift it has, and that no chains or obstructions are in the way while the telpher is in opera-

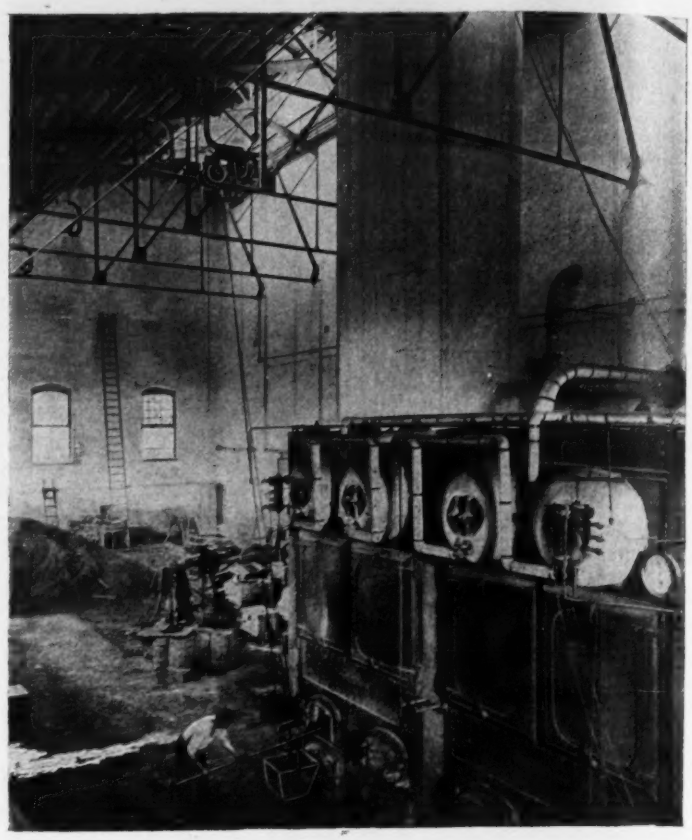


FIG. 2.—LOADING ASHES AT THE BOILERS.

tion. The hoist is automatic in stopping when it reaches any desired height, independently of the will of the operator. The bucket is self-dumping and self-righting, dumping its load automatically in the chute at the end of the line, where the trigger projection from the bucket comes in contact with the tripping device. This plant is not only able to handle all the ashes produced, but is capable of doing more than double the work required.

The costs of operation and maintenance of this plant are stated to be exceedingly low. There are no wheels, sheaves or chains to be

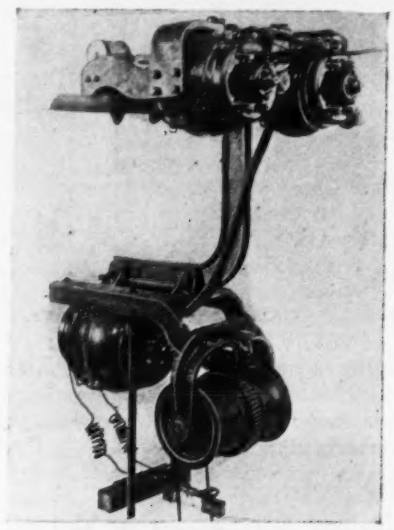


FIG. 3.—TELPHER AND ELECTRIC HOIST.

oiled, merely the axle of the motor. This telpher differs from mechanical telphers, etc., in that the motors are all on one side. The track consists of steel cable supported from the girders and the results have been exceedingly satisfactory to all concerned.

The United Telpherage Company, of 20 Broad Street, New York

City, is installing many other plants, all involving some new and important principles and departures from the ordinary standard work,

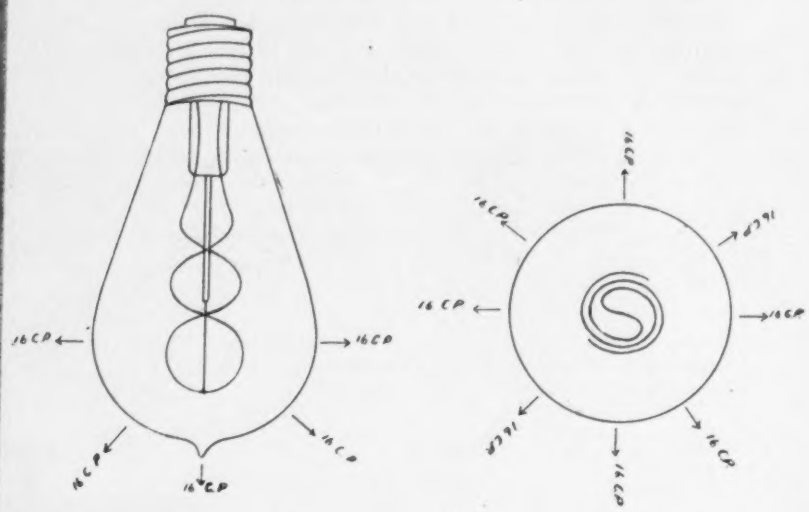
FIG. 4.—DUMPING INTO CHUTE.

but for which the flexibility of the system and the fact that it is overhead and out of the way gives it numerous special advantages.

The Sterling Incandescent Lamp.

For the past several years much has been written, and much more has been talked to central station men on the subject of the distribution of light from incandescent lamps. Authorities on illumination have, as a rule, contended that the candle-power of an incandescent lamp should be expressed in terms of spherical candle-power, but the objection has been urged against this that even assuming this method to be the only correct one, the difficulty of determining spherical candle-power is so great as to render this system of rating impracticable so far as central stations are concerned. As against the present method of rating lamps in terms of horizontal candle-power the National Electric Light Association recommended that measurements should be taken 45 degs. below the horizontal, but subsequently withdrew this recommendation. It has also been contended that the only rational system of rating is one made in terms of the light from the tip of a lamp.

The Sterling Electrical Manufacturing Company, of Warren, Ohio, has placed on the market a lamp which, it is claimed, harmonizes all of the strong points in the arguments offered for the different methods of rating above outlined. The lamp is shown in the accompanying illustrations, and the distribution of light is represented in both a vertical and a horizontal plane. Fig. 1 shows that in a vertical plane the form of filament used giving an equal illumination at every angle, except, of course, that corresponding to the base of the lamp. Fig.

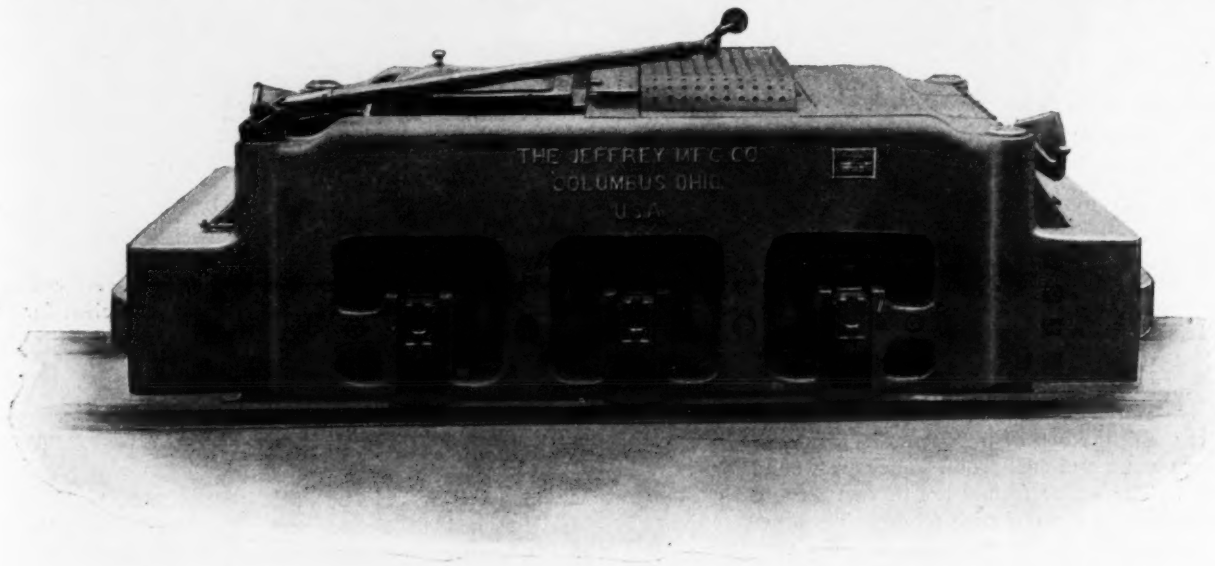


FIGS. 1 AND 2.—DISTRIBUTION OF LIGHT.

2 shows that the illumination is precisely the same at all angles in a horizontal plane. It is claimed that this is the only lamp made that will give the same measurement in candle-power when revolved or stationary and at any angle.

A Recent Type of American Electric Mining Locomotive.

The coal operator who opened his mine but a few years ago, and employed mules for hauling his coal, soon found that some quicker means was necessary for delivering coal to the tipple. The convenience and simplicity of electric haulage was early recognized, and the increasing demand for electric locomotives is ample evidence that they have met every requirement of the mine. The necessity for locomotives of large capacity has grown with the output of the mine, but the original low and narrow entries have proved a serious obstacle to their use. To meet the demand for a locomotive of large hauling capacity and yet of so compact a form that it can be used in the average entry, the Jeffrey Manufacturing Company, Columbus, Ohio, has brought out among its later designs the 20-ton locomotive shown in the illustration.



MINING LOCOMOTIVE.

The rated draw-bar pull of this locomotive is 8000 lbs. The speed

ranges from 6 to 10 miles an hour, depending on the load. Under test the locomotive developed over 11,000 lbs. draw-bar pull before the wheels slipped. The motors, however, are of ample capacity to skid the wheels on the best track when using sand. It is equipped with three 60-hp motors, each geared to an independent axle and pair of drivers. Dividing the power between three motors effects a great saving in the width and height of the locomotive over one of the same capacity having but two motors.

The drive wheels are pressed on and keyed to special hammered open hearth steel axles. The wheels themslves are of the open plate cast iron type with chilled thread. The axle journal bearings are of a type which meets the approval of the Master Car Builders. They are made of a very tough and durable bearing metal, and are of sufficient size to make the pressue on the journals well within the safe limit. The wheels being inside the locomotive frame, the axle journal bearings are accessible for oiling, or for renewing the linings. The journal boxes are dirt-proof, which insures long life to the bearings.

The frame of the locomotive is of massive iron castings, rigidly bolted together with heavy steel bolts, and supported by equalizing leaf springs, which rest in suitable chairs on the journal boxes. The frame covers are of sheet iron hinged in such a manner as to allow easy access to all interior parts of the locomotives. The brake mechanism is very simple but effective. Pressure on the six brake shoes is equalized by a system of levers. The brakes are operated by a screw which is keyed into the hub of the hand wheel. No ratchets and pawls are necessary for locking this brake mechanism, as the screw makes it self-locking in any position. The mechanical advantage is such that the operator can easily skid the wheels of the locomotive. Sand boxes of large capacity are provided at both ends of the locomotive and the operating levers for the sand valve are placed within convenient reach of the operator.

The motors are water and dust-proof. They are wound for either 220 or 500 volts. The motor frames are of cast steel, designed to meet the exacting requirements of mine service. The armature shafts are made of high-grade crucible steel, and both the armature shaft and axle bearings are made of the best bearing bronze obtainable, carefully bored to alignment and scraped to fit before assembling. The commutators are made of drop-forged copper segments insulated with the best mica.

The controller used on the locomotive is the Jeffrey Class 9. It has specially large, milled contacts, and is so arranged that the motors may be run either in series or in parallel. The operating levers are conveniently located. The resistance coils, which are of ample capacity, are located at the top of the locomotive, and so arranged that there is a constant circulation of air about them, which keeps them cool. On either side of the locomotive frame is a cored receptacle for the Jeffrey standard trolley base which admits of the trolley pole being placed to suit the mine wiring.

Every motor used on the Jeffrey locomotive is given a full-load and overload test being placed in position. After the locomotive is complete, it is placed in a special testing frame and made to run the equivalent of several miles under load in both directions. It is also subjected to a series of severe electrical and mechanical tests in order that any defects of any sort may be discovered before shipping.

The machine shown in illustration is stated to be the largest and most powerful electric locomotive for mine use which has yet been built.

Eureka Telephone Apparatus.

In the accompanying illustration is shown one of the latest types of switchboards made by the Eureka Electric Company, of Chicago. It is a toll line and chief operator's board, equipped with the new Eureka lever, and with the Eureka tubular drop. All contacts of this board are made on hard rubber of thickness efficient for any strain that can be placed upon a switchboard.

TELEPHONE SWITCHBOARD.

An Electro-Mechanical Railway Switch.

Mr. Gwynne E. Painter, of Baltimore, Md., has lately patented what is termed an electro-mechanical switch for suburban lines, which is operated by a passenger and electrically reset by a passing car, and not only signals to a car to stop at night, but also lights a lamp while waiting.

On the part of the arrangement handled by the passenger are the directions, "To stop cars at night, push down handle." When this handle is pushed down, the lights above are lit. This gives light for the passenger while waiting and also a signal to the motorman to

stop. Once the light is lit, it cannot be put out again, except by the car itself.

The switch operated by the passenger is encased in an iron box and

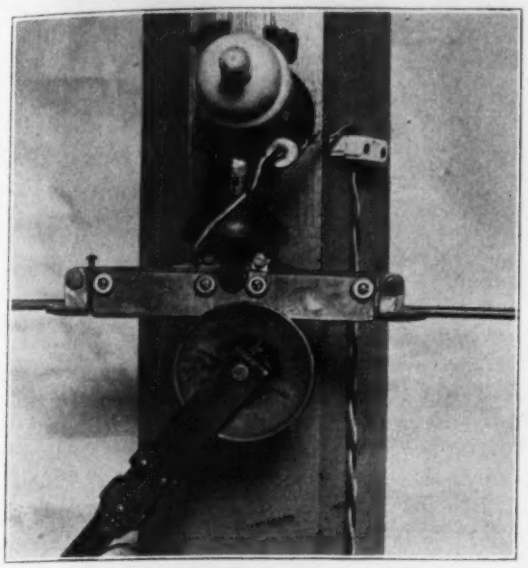


FIG. 1.—VIEW OF SWITCH.

so thoroughly insulated as to be impossible to give a shock. It consists of only one magnet and an armature. This magnet is 1 inch by 2, and wound with No. 26 wire. When it is in shunt with 500-volt railway current passing through five 16-cp lamps in series, there is only a difference of potential of three volts. The short circuiting device on the trolley which resets the switch after it has served its purpose consists of a U-shaped piece of brass, and is fastened to the trolley by laying the wire in the bottom, then placing a bar on it, which is made fast to the U by screws. This bar will then clamp as well as support the trolley. A part of one side of this U piece is insulated both from itself and the trolley.

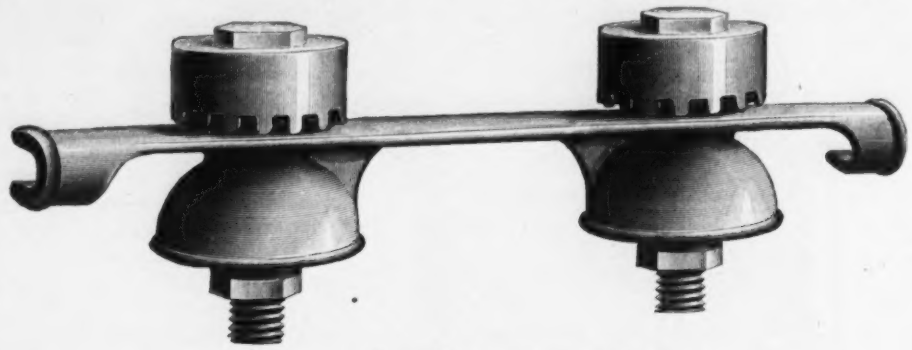
A wire from the trolley leads to one end of the magnet in the switch box; the other end is made fast to the frame and magnet core. It will be seen that the circuit is broken until the armature is raised up and touches the core, when the current then passes through the armature, to the lamps, thence to the ground completing the circuit. At the same time, it causes the magnet to hold the armature

FIG. 2.—OPERATING THE SWITCH.

to itself, and thus maintain the lights in operation. When the car arrives and the passenger is on, the trolley wheel runs on a short-circuiting device; as has been before stated, a part of the U is insulated from the other, and the trolley wheel connects these both together. This will cause the current also to go through a wire from this insulated part to the frame and core of magnet, which practically short circuits it. This makes the magnet so weak that it will not hold the weight of its armature, which drops back to its original position, thereby opening the circuit and putting out the lights. It has been calculated that if the trolley wheel rests only 1-20 part of a second on this U, it will reset the switch.

"Twin" Type of Trolley-Wire Hangers.

In the construction of single-track electric roads built on modern lines, it is usual to employ two trolley wires instead of one, in order to avoid the necessary complication of overhead frogs and switches required where only one trolley wire is used with switches at the turnouts. The twin type of trolley wire hanger has been designed to



"TWIN" TROLLEY WIRE HANGER.

properly support two parallel trolley wires and maintain them at a fixed distance apart, and this type of hanger has been found superior for this purpose to the use of two single hangers on account of the greater rigidity in the support of the two wires in respect to each other.

A form of twin hanger manufactured by the Ohio Brass Company, of Mansfield, Ohio, is shown in the accompanying cut. This style of hanger is also made in both single and double curve forms for use on curves, and each of these is a modification of the regular forms of the corresponding hangers for single trolley wire suspension.

Telephone Systems in Private Houses.

The private house of to-day, instead of being equipped with a speaking tube as was the custom a few years ago, generally has a modern telephone system connecting the various departments with each other. The main advantage of the telephone over the speaking tube is that one outlet or one telephone can be used to communicate to all of the different stations, whereas when the speaking tube was used a separate mouthpiece was needed for each and every station. As to locating these outlets for the telephone, a very convenient place is near the casing of the door, as it is not practicable to place any heavy article of furniture near a door. Caution should be used in first discovering which way the door is to swing.

The wire cable, which is used in connecting the various stations, should run as far from the water pipes as possible on account of breaks in the pipes which are liable to occur and the moisture from which would injure the wires, make cross connection, cause leaks of current and soon destroy the vitality of the battery. A cable having a weather-proof insulation is preferable, not only on account of the properties which prevent moisture from entering the same, but also because a cable of this kind is not attacked by rats or mice, which by gnawing the insulation are apt to cause crossing or grounding.

Wall pockets or receptacles for holding the telephone are very use at the outlets, for while keeping the telephones fully covered, they do not deface the walls, and by their use many of the connections can be made inside and a buzzer or a bell can be placed within for the purpose of calling that station. The telephone itself can be very small and compact, and by using a hand microtelephone in connection with a selective switch, an instrument having capacity of 15 stations will occupy a space of only four or five inches square.

There is no limit to the flexibility of a system of this description, as any station can call all the departments or it can be so wired as to call only a certain few. Arrangements should be made for bringing the cable to a point where it can be attached to wires going to the stable, greenhouse, etc., these connections being especially convenient for the lady of the house, as in ordering the carriage for a drive, etc.

By a simple attachment in the owner's chamber, the telephone sys-

tem can be instantly converted into an alarm system, and all the bells be made to ring at one time by the simple pressure of a special lever. This can be used in case of fire, burglars or sickness, and is very valuable in suburban residences.

As to the construction, the cable itself should be installed while the house is in process of construction and should be put in place before the studding is covered with lath and plaster. The instruments themselves should not be placed on the wall until all the workmen

FIGS. 1 AND 2.—TELEPHONES FOR PRIVATE RESIDENCES.

have left the building for good, as telephones are apt to be regarded as an object of curiosity by workmen doing other work and oftentimes considerable damage is done by their carelessness.

The accompanying illustrations show two simple instruments which are well adapted for household purposes, such as above described, and are reasonable in cost. These and other patterns are made by the Ericsson Telephone Company, No. 296 Broadway, New York City.

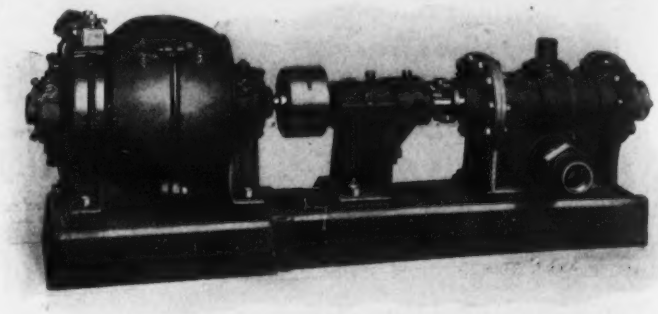
Electric Canal-Towage.

Work on the construction of the line of the Miami & Erie Canal Transportation Company has been in a fair state of progress for some weeks, and the Cleveland Construction Company, which is building the line, reports that the first division of the canal, from Cincinnati to Dayton, will probably be in operation by Jan. 1. The entire line from Cincinnati to Toledo will be completed, it is claimed, by Jan. 1, 1903. The project presents a number of new departures in electrical engineering, not the least of which is the fact that the cars will be equipped with alternating-current motors.

The Construction Company has recently placed contracts with the Westinghouse Company aggregating over $80,000. To start with, there will be six motor cars, or electric locomotives, for towing the canal boats. Each will be equipped with two 125-hp alternating-current motors. In the city the current will be delivered at 380 volts and in the country at 1100 volts. Along the first section of the line there will be four transformer stations, and current will be delivered from lighting plants in the various towns at 33,000 volts. When towing boats the locomotives will have a speed of three miles an hour, but by cutting out one of the motors this can be increased to six miles an hour, when it is desired to cut loose from the boats.

Motor for Electro-Hydraulic Plant.

Conveying water by an electrically operated pump was one of the earliest applications of the electric motor. To-day the electric motor is an important factor in supplying water in the tall office buildings where the street service is inadequate. The accompanying illustration shows a modern equipment consisting of a Lundell round type enclosed motor direct connected to a Quimby screw pump. The motor and pump are usually placed in the cellar and the water is forced to the top of the building to a pressure tank which is provided with a regulator for throwing the motor into action as often as necessary. This keeps the apparatus in perfect working condition and always ready to respond to any demand. The current may be obtained from the street or isolated plant. The design and con-



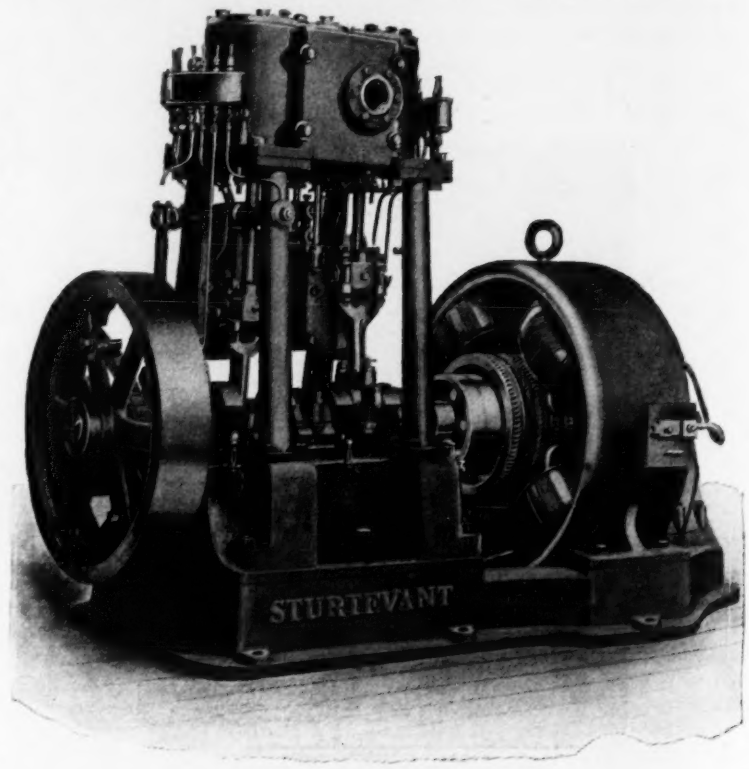
ELECTRICALLY-DRIVEN PUMP.

struction of the Lundell motor make it easily adaptable to all kinds of pump driving, and its high efficiency and remarkable endurance under exacting conditions of service give it an important commercial value.

Compact Generating Set.

In the accompanying illustration is presented one of the latest designs of a Sturtevant generating set, consisting of an open type vertical compound engine and four-pole generator. In this design the bed carries three main journal bearings, brass bushed in their lower halves and provided with continuous oiling devices in connection with oil reservoir beneath. Its interior is formed into a basin which collects all drip from water or oil. The four heavy upright columns are securely fastened to this bed, and to their upper ends is bolted the single cylinder casting, comprising the two cylinders, which are of relatively large diameter and short stroke. Two piston valves are operated in unison by a single rocker and yoke, each regulating the admission of steam to one cylinder.

The cross heads are of the slipper type, with projecting cross-head pins. The connecting rods have yoked cross-head pin ends and are



GENERATING SET.

of large size. Complete sight feed oiling arrangements are provided for all bearings. These engines are built for an output at 150 lbs. of 47.5 and 60 horse-power.

The armature shaft is direct connected to the engine shaft, and carries an armature of the barrel wound toothed drum type with slotted disks of carefully annealed sheet steel, which after being coated

with an improved insulated varnish is mounted upon a cast iron drum. This drum is provided with longitudinal air ducts, which connect in turn with radial ducts passing through the core and by means of small blades or vanes inserted in these ducts, compel the circulation of a constant current of air, thereby greatly facilitating ventilation and insuring an extremely cool running armature.

The winding for all low voltage machines is of copper bars. High voltage or very slow speed machines have the armature wire wound with machine formed coils, which coils are thoroughly insulated before being placed upon the core. The magnet frame is of special magnet steel and has the field cores cast therewith. The ring is cast in one piece.

The commutator consists of drop forged copper segments, mounted upon and secured between cast iron flanges of spider construction which allow a circulation of air inside as well as outside and conduces to low temperature. Carbon brushes only are used in these machines mounted in holders of the sliding socket type with easy facilities for adjustment and removal. A full load run for a sufficient length of time to bring every part to its maximum temperature has never been found to produce a temperature rise exceeding 40 degs. C.

Belt Conveyors as Ash Handlers.

The disposition of the ashes from a large power plant is not less a matter of interest than the bringing in of the coal. Street railways offer a large field for the application of special methods, and we illustrate herewith a 16-inch Robins belt conveyor in use at the Ninety-sixth Street power plant of the Metropolitan Street Railway Company, in New York City. The maximum capacity of the plant being 70,000 horse-power, the ash problem is a serious one, but this conveyor has for two years handled all the ashes produced, and is still in excellent condition. In the Robins conveyor pure rubber is the only material which comes in contact with the substance conveyed. For this reason the conveyor is entirely unaffected by the sulphurous acids which are present in all coal ashes and which have a strongly corrosive effect on iron and steel. A revolving brush effectively removes anything which may stick to the belt, and thus prevents dripping of ashes and water on the return run.

CONVEYOR HANDLING ASHES.

Storage Battery for Telegraphic Use.

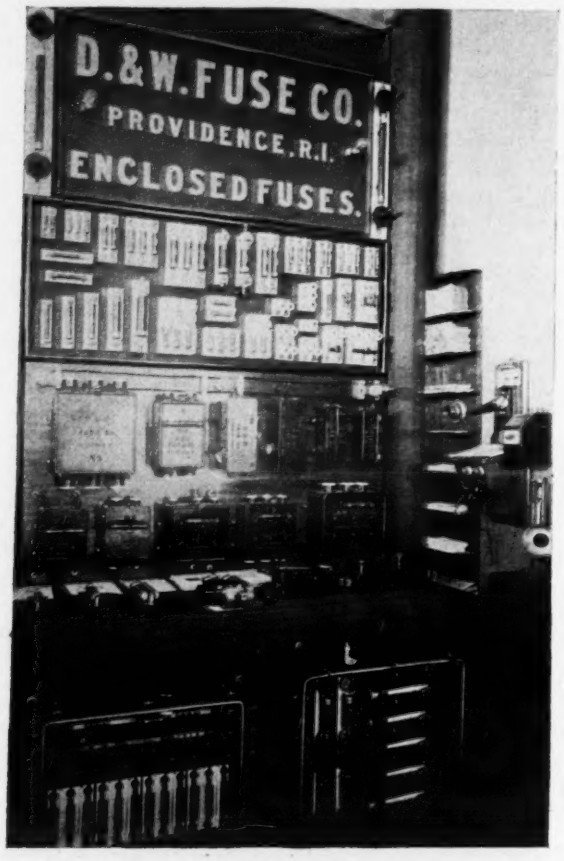
The Electric Storage Battery Company, of Philadelphia, appreciating the demand for a battery of small capacity especially adapted to telegraph and fire-alarm service, has placed on the market three types of the "Chloride accumulator" known as the B. T., C. T. and P. T. cells, having a capacity of 6, 12 and 24 ampere-hours, respectively at the eight-hour discharge rate. These types are of novel construction, the positive and negative plates having their lugs or straps cast or burned together so that the "couplet," as it is termed, is shipped to the purchaser in one section by reason of which the only labor required in setting up a battery of these elements is to insert the plates in the jars. This makes the installation a most simple matter, and avoids the necessity of connectors or lead burning. Two plates constitute a complete element of this type, and the simplicity of installing together with the high standard of excellence which characterizes all types of the "Chloride accumulator," makes this new type a most up-to-date battery equipment for telegraph and fire-alarm stations.

D. & W. Fuses at Buffalo.

One of the interesting exhibits of the Pan-American Exposition is that of the D. & W. Fuse Company, of Providence, illustrating a remarkable development of that specific type of apparatus, viz., fuses. This company has on exhibition a complete line of enclosed fuses for various services from 250 volts and less up to 10,000 volts, exhibiting not only the various types of fuses but also fuses of different capacities for different circuits. In addition to this, it shows a complete line of porcelain cut-outs for various work, such as motor protection, lighting, transformers, etc.

Its exhibition of subway boxes is also remarkable, inasmuch as it is, we believe, the only concern now manufacturing an extensive line of subway boxes equipped with enclosed fuses. These boxes are by no means experimental, since this company has been manufacturing and installing them for a considerable time, and this portion of its exhibit will be found particularly interesting to those who contemplate work in that direction.

Its line of service switches, transformer and junction cut-outs also contains much of interest to all central station superintendents.



FUSE EXHIBIT.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed at 3½ per cent; time money, 4½ per cent for all dates on high grade securities. Mercantile paper is quoted at 5 per cent for the best names for four to six months, and 5½@6 per cent for others not so well known. In the stock market there was greater activity, which, however, was mainly at the expense of prices. The influences which affected the market were related partly to monetary conditions and partly to the position of certain stocks and stock market interests. The principal incident of the week was the heavy break in Amalgamated Copper and in the stock of its auxiliary, the Anaconda Mining Company. This was a result of the reduction of the Amalgamated's dividend from an 8 per cent basis to one of 6 per cent per annum, followed as it was by the reduction of the Anaconda Company's dividend. The general railroad list was unfavorably affected by the break in copper. United States Steel stocks exhibited strength the latter half of the week on reports that, notwithstanding the strike, the earnings for the quarter were fully equal to those of the first three months after the corporation's organization. Electric and traction securities felt the depressing influence of the general market, and in all cases the closing quotations show declines as compared with the prices at the close of the previous week. General Electric wavered between 256½ and 261¼, closing at 260, which is a net loss of 3⅞ points; Western Union lost 1⅛ points, having fallen as low as 89¾, the closing price being 91⅜. Brooklyn Rapid Transit fluctuated between 65½ and 69½, closing at 67, the net loss being 2¼ points. Metropolitan Street Railway closed with a net loss of 1¾, closing at 164½ ex dividend. Following are the closing quotations of Tuesday, Oct. 1:

NEW YORK.

	Sept. 24	Oct. 1.		Sept. 24	Oct. 1.
American Tel. & Cable..	—	—	General Carriage.....	1	1
American Dist. Tel.....	—	—	Hudson River Tel.....	114	114
Brooklyn Rapid Transit..	67½	64⅛	Illinois Elec. Veh. Trans.	¾	—
Commercial Cable.....	—	—	Metropolitan Street Ry...	166¾	162½
Electric Boat.....	18	16	N. E. Elec. Veh. Tran..	—	—
Electric Boat pfd.....	44	40	N. Y. Elec. Veh. Tran...	10	10
Electric Lead Reduc'n...	2	2	N. Y. & N. J. Tel.....	166	166
Electric Vehicle.....	3½	1	Tel. & Tel. Co. of Am....	6	5
Electric Vehicle pfd.....	7	4	Western Union Tel.....	91½	91
General Electric.....	—	257½			

BOSTON.

	Sept. 24	Oct. 1.		Sept. 24	Oct. 1.
Am. Tel. & Tel.....	164	159	Mexican Telephone.....	2¼	2
Cumberland Telephone...	—	—	New England Telephone.	—	—
Boston Electric Light....	—	—	Westinghouse Elec.....	—	—
Erie Telephone.....	38	39	Westinghouse Elec. pfd..	—	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Sept. 24	Oct. 1.		Sept. 24	Oct. 1.
American Railways.....	40¾	41	Phila. Traction.....	95¾	95¾
Electric Storage Battery..	65	60	Philadelphia Electric.....	5½	5½
Elec. Storage Batt'y pfd..	65	60	Pa. Electric Vehicle.....	½	½
Elec. Co. of America....	7	7	Pa. Elec. Veh. pfd.....	½	½

CHICAGO.

	Sept. 24	Oct. 1.		Sept. 24	Oct. 1.
Central Union Telephone.	45	—	National Carbon pfd.....	83	83
Chicago Edison.....	170	168	Northwest Elev. com....	38½	37
Chicago City Ry.....	201	202	Union Traction.....	17¼	17½
Chicago Telep. Co.....	—	255	Union Traction pfd.....	58	58
National Carbon.....	17¾	18			

SALE OF PITTSBURG TROLLEYS.—The Monongahela Traction Company, owning 25 miles of track in Pittsburg and up the Monongahela Valley through Wilkinsburg, Braddock, Homestead, Duquesne and McKeesport, and the Pittsburg & Birmingham Traction Company, owning 28 miles of track in Pittsburg, have been sold to the Widener and Elkins syndicate, of Philadelphia, according to the best information obtainable. Both lines are controlled by W. T. Mellon. He built the Monongahela line and a few months ago purchased the Birmingham property. The Monongahela Company is capitalized at $1,000,000, and is bonded $2,400,000. The Pittsburg & Birmingham has $3,000,000 stock and $3,500,000 bonded debt. The Widener and Elkins people control the Philadelphia Company, of Pittsburg, which controls the gas and electric business of Allegheny County, and the United Traction Company, which absorbed ten street railways in Pittsburg and Allegheny City. The purchase is understood to be a final step in the matter of combining all traction interests of the county, including the Consolidated Company, of Pittsburg, the big concern of which the late Senator C. L. Magee was president, into the one corporation. The scheme is further said to contemplate the merger of all companies in Allegheny and Philadelphia counties.

BOSTON EDISON.—The annual meeting of the Edison Electric Illuminating Company will be held Oct. 8. Stockholders will be asked to approve an issue of $750,000 additional stock. Should the new issue be authorized, stockholders will be given the privilege of subscribing for the new stock at the ratio of 1 share for 10, and at a price to be fixed by the gas commissioners. Of the 30,000 shares of Boston Electric Light Company stock, 29,500 shares have been deposited with the Old Colony Trust Company under terms of consolidation with the Edison Company.

WOODS MOTOR VEHICLE COMPANY.—Acting on the request of O. J. Friedman, one of its largest stockholders, Judge Kohlsaat in Chicago has appointed Max H. Whitney receiver of the Woods Motor Vehicle Company. Mr. Whitney qualified promptly by giving a $100,000 bond. It is said the action is brought with the intention of reorganizing. "The business is solvent and there is no reason why it should not continue," said Attorney Smith. "The assets are $250,000, and the liabilities less than $120,000."

WORCESTER TRACTION.—At a special meeting of the directors of the Worcester Traction Company resolutions were adopted to decrease the preferred stock from 20,000 to 400 shares and that the 19,600 shares of preferred stock previously called for redemption be cancelled. The resolutions give notice of a meeting of the shareholders for Oct. 7 to take action on the directors' recommendation. President Thomas C. Barr said that the directors' action is one of the final steps in winding up the company's affairs.

DIVIDENDS.—A quarterly dividend of 1½ per cent has been declared by the directors of the Central & South American Telegraph Company, payable Oct. 8. The Washburn Wire Company has declared the regular quarterly dividend of $1.75 per share on its preferred stock, payable Oct. 1 to stock of record Sept. 26. New York & New Jersey Telephone Company has declared the regular quarterly dividend of 1½ per cent, payable Oct. 15.

CONNECTICUT RAILWAY & LIGHTING.—Application has been received by the committee on Stock List, New York Stock Exchange, to list Connecticut Railway & Lighting Company's $15,000,000 1st refunding mortgagee 4½ per cent 50-year gold coupon bonds of 1951.

Commercial Intelligence.

THE WEEK IN TRADE.—According to reports made to the mercantile agencies trade in nearly all lines is still running full, and in some the tide is still rising, as shown by a firmer tone or actual advances in the level of prices. The features in distributive trade are the good tone of advices from the jobbing West, Northwest and Southwes , and on the Pacific Coast, and the better retail trade reported at the East, due to the seasonable weather. In the iron trade there appears to be exceptional activity, with orders extending well into next year. Steel rails are in good demand, and so active has been the inquiry that the amount of old orders to be carried over for delivery next year is estimated at from 250,000 to 400,000 tons. The business failures for the week, as reported by *Bradstreet's*, numbered 197, as against 158 the week previous and 169 the same week last year. Copper was depressed and nominal. Some business was done for early shipment, and there was a good inquiry for October and November shipment. Lake is quoted, 16½c.; electrolytic in cakes, wire bars and ingots, 16¼c.; cathodes, 16c., and casting stock, 16c.

CABLES AND TELEPHONES IN GREECE.—United States Consul Jackson, of Patras, under date of Aug. 23, 1901, reports that the Eastern Telegraph & Cable Company is constructing a third cable from Zante via Patras and the Corinthian Gulf to Syra, the object being to offer a more direct wire communication between Europe and India and Australia. The two old cables will be devoted principally to local needs, the volume of business having greatly delayed rapid communication and justified the laying of the third. There is, further, under serious consideration the construction of a telephone line between Patras and Athens. While the project, says the Consul, has so far taken no definite form, the business done between these two points will undoubtedly justify the undertaking. The amount of materials necessary for the equipment of such a line will be sufficiently large to merit the close consideration of American manufacturers. As soon as facts with regard to the proposed line appear, they will be furnished by the consul to those who may be interested.

SOME C & C FOREIGN AND DOMESTIC ORDERS.—The C & C Electric Company reports receipt of a contract from Mr. Charles R. Heap, 47 Victoria Street, London, S. W., which calls for a number of motors varying from 5 horse-power to 20 horse-power. These equipments are intended principally for installation in British manufacturing plants, where they will be utilized for operating machine tools. Some of the motors referred to will be furnished to the Thornycroft torpedo boat building plant at Chiswick. Domestic contracts recently secured include orders for one 90-hp and one 20-hp slow-speed variable speed motors to be used in the pumping station of the city of St. Louis, Mo.; one 40-hp special variable speed motor to drive a pump at Bushey & Hanley's Dry Dock, Jersey City; one 3-kw generating set and switchboard for Morris & Cummings Company, New York City; one 40-kw generator, also a 12-kw one for sugar plantation use ordered by H. Widener, New Orleans, La.; one 125-kw generator and one 90-hp motor for High Point (N. C.) Machine Works & Lighting Company; one 60-hp motor, one 50-hp motor, one 40-kw dynamo and one 20-kw dynamo for Miller Electric Company, of Newark, N. J.; one 40-kw dynamo for lighting purposes requisitioned for by Bedford (Ind.) Quarries Company; one 16-kw dynamo, switchboard, wiring, etc., for American Sanitary Company, Elizabeth, N. J.; one 15-hp motor and one 25-hp motor, enclosed, for Washington Navy Yard; generating sets and switchboards for Quebec Steamship Company's "Monmouthshire," and Latrobe (Pa.) Brick Company; one 25-kw generator for American Hard Fibre Company, of Newark, Del.; eight 5-10-hp motors for De Laval Separator Company, of Poughkeepsie, N. Y., and the same number of large slow-speed motors, which are to be utilized for driving blowers and ventilators in the new Stock Exchange, New York City.

CHARLES E. DUSTIN COMPANY.—Brief reference has been made in these columns to the formation of the Charles E. Dustin Company, at 11 Broadway, New York City, where it will engage in the purchase and sale of all kinds of electrical machinery, engines, boilers, etc., and also undertake a general engineering business such as the construction of electric and steam plants and other work. Mr. W. S. Barstow, formerly general manager of the Edison Electric Illuminating Company, of Brooklyn, whose recent start as a consulting engineer was noted in these pages, has been retained as consulting engineer for the new company, and will devote a large part of his time to its interests. The capital stock of the Charles E. Dustin Company is $250,000, and the company will be fully prepared to cover all special branches of the business which it now undertakes. Mr. Dustin, who is the president of the new organization, is peculiarly fitted for the business of buying and selling second-hand material, having long been identified with electrical companies as a confidential financial expert in these lines. He was the founder of the well-known Schuyler Electric Company, which was afterward absorbed by the General Electric Company, and was later made receiver of the well-known Excelsior Electric Company, during the negotiations which were then being made to purchase the Excelsior Company by the General Electric Company. It was through his receivership in this company that he became connected, as president and general manager, with Rossiter, MacGovern & Co., when, as it will be remembered, they bought the Brooklyn plant of the Excelsior Company for their own repair business. Mr. Dustin is not likely to let the opportunities in his new field of work escape him, and they are many for one of his experience and ability.

EDISON IRON ORE SEPARATION.—Mr. Joseph Lawrence Member of Parliament for the Monmouth District, who recently returned from the United States, addressing the Newport Chamber of Commerce last week, made a most interesting and comprehensive statement of the causes of American superiority in the steel trade. He told his audience that Charles M. Schwab assured him that the United States Steel Corporation could deliver steel billets in England for $16.50 per ton, whereas the lowest price for which British manufacturers could make them was $19. Mr. Schwab also informed him, Mr. Lawrence said, that when the trust had completed certain ocean transportation arrangements now pending, the American price would be still lower. In addition to this statement, Mr. Schwab called the attention of Mr. Lawrence to the fact that his steel workers got double the wages paid British workmen in the same line. Mr. Lawrence went on to draw a striking contrast between freight charges in Great Britain and the United States, showing that the cost of carrying steel from Pittsburg to New York was less than the cost of carrying it from Birmingham to Liverpool, although the distance between the two English cities was only one-quarter of that between the American cities named. Having pointed out that it would be also necessary to resort to cheaper ores, Mr. Lawrence announced that as a result of several years' study of these problems, and consultation regarding them, he and Mr. T. A. Edison would shortly begin business in Norway with the idea of supplying to Great Britain cheaper ores extracted by Edison magnetic separation process.

OUR TRADE WITH GERMANY.—A great number of protests are coming from all quarters in the empire against the paragraph in the new tariff bill which prohibits commercial treaties because of its minimal tariff on grain. The *Kreuz Zeitung*, in an article on "American Competition in the World Market," says: "Undoubtedly the American protective tariff has proved most advantageous to the economical deliverance of the New World from the Old. The United States increased their total exports from 835,000,000 marks in 1870 to 1,394,000,000 marks in 1900, while their imports increased only from 667,000,000 marks to 849,000,000 marks. Professor Blondel calls such phenomenal progress 'alarming.' This is correct; but, on the other hand, the figures show how the United States depend upon their treaty relations with countries importing their products. In that enormous prospecity have participated their agricultural and industrial products, as iron, textiles, coal, minerals, cast iron and the like. Their wheat export has continually increased, and so has their cattle raising. Germany imported in 1889 products of the United States to the value of 272,000,000 marks, and in 1898 to the value of 620,000,000 marks, or an increase of 130 per cent. Professor Blondel attributes the success of the United States mainly to the wonderful organization of labor, the matchless development of industry by means of the latest machinery, the energy of the gigantic trusts which aim at the economical conquest of the Old World, and to united commercial and scientific boldness."

CONDITIONS IN COPPER.—As to the possibilities of the copper situation, the *Engineering and Mining Journal* says: Some of the leading interests are of the opinion that the conditions in Germany will improve at an early date. This may be an optimistic view. The demand in this country is brisk at the present artificial prices, and if exports for this year were equal to those of 1900, there would be little spot copper available. Notwithstanding the present muddled condition, the prices this year have exceeded the average for last year, which was 16.19 cents for electrolytic. The price this year has averaged 16.35 cents. These prices have been so much higher than those ruling abroad, that some refiners have found it profitable to import Chili bars and other unrefined copper for refining here. The whole situation may be said to depend upon the inclination of the Amalgamated Copper Company, and as no one outside of that company knows what action it will take, the business being done is of the hand-to-mouth order. We can say, at least, that the situation is in strong hands. The Amalgamated Copper Company, together with its allied interests, control between 55 and 60 per cent of the copper production of the United States, and are in a position to dictate prices. The outside interests are, however, getting the greater benefit from the present condition.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material from the port of New York for the week ended Sept. 25: Antwerp—2 cases electrical machinery, $150; 18 cases, $1,515. Argentine Republic—52 cases, $1,171; 30 cases, $3,800. Amsterdam—1 case, $20. Azores—1 case, $46. British East Indies—7 packages, $460. Brazil—16 packages, $715. Bristol—9 cases, $500. Bale—1 case, $30. British Australia—113 packages, $9,939; 151 packages, $8,708. Berlin—4 packages electrical machinery, $50. British Possessions in Africa—3 cases, $58. Cuba—24 cases, $419. Chili—12 packages, $207. Central America—32 packages, $288. Ecuador—1 package, $54. Glasgow—1 package, $47. Havre—14 cases, $377; 2 cases electrical machinery, $90. Hamburg—5 cases, $235; 40 cases, $1,550. Japan—14 cases, $995; 20 packages, $6,600. London—141 packages, $5,100; 159 packages electrical machinery, $5,203. Lisbon—20 packages electrical machinery, $5,560; 5 cases, $146. Leeds—1 case, $101. Liverpool—12 cases, $1,643; 73 cases, $3,028. Leicester—1 package, $70. Mexico—150 cases, $9,198. Manchester—1 case, $30. Philippines—6 packages, $240. Southampton—7 packages, $346. Uruguay—4 cases electrical machinery, $275.

BRITISH GUIANA.—The Colonial Trading Exploitation & Trading Company, Bowling Green Building, is about to erect two or more plants along the Atlantic seaboard in which electrical machinery will it is anticipated, be largely employed. The company is reported to have acquired large tracts of china clay lands in British Guiana. From the various borings already made on the property it is estimated that some 23,000,000 tons of clay is in sight. The company will import the product into the United States, and will construct a plant for the processing of clay. Another plant is to be built along this seaboard for the making of masticks to be used in the construction of buildings. Motors, it is said, will be largely used in this plant. Stone crushers, mixers, etc., will also be required.

EXTENSION OF MEXICAN TRAMWAYS.—Mr. A. E. Worswick, the resident manager of the Compania Limiteda de Tranvias de Mexico (the Mexican Tramways Company, Limited), City of Mexico, has returned from his European trip, and is placing contracts for the equipment, etc., requisite for the extension of the road. The J. G. Brill Company, of Philadelphia, has secured a contract for several trucks. Mr. Worswick is staying at the Holland House.

ROSSITER, MACGOVERN & CO.—An interesting development to all engaged in the electrical and street railway field is the recent election of Mr. Clinton L. Rossiter, formerly president of the Brooklyn Rapid Transit system, to the presidency of the above well-known concern of dealers in steam and electrical machinery. Mr. Rossiter's executive ability and wide experience of affairs render him specially competent to take up the commercial questions arising in the development of electric lighting and street railway enterprises. Vice-President Frank MacGovern is known to nearly every street railway man in the country. He has built up a phenomenal business in street railway machinery by his remarkable ability and by his great popularity in the trade. An evidence of his energy and resourcefulness was afforded when at the time of the Paris Exposition a large equipment of street railway apparatus was lost on the "Pauillac," and in less than a couple of weeks he had actually picked up and loaded on to the next available steamer some 3000 kilowatts for the Compagnie Generale de Traction then waiting to install it. We are informed that the concern proposes to extend and enlarge the scope of its business, and has already established a branch office and warehouse in St. Louis, besides opening another at Cincinnati, for the purpose of enabling the company to come in closer touch with its patrons in those territories and make more prompt deliveries.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY reports a very satisfactory year in its pole business. The company entered the field about January of the present year and secured from producers in the vicinity of Escanaba, Mich., a very large stock of white cedar poles, with an idea of furnishing them to telephone companies in connection with its switchboard and telephone business. It supplied a large number of poles for the independent plants at Jackson and Detroit, Mich., and Columbus, Ohio, and also made heavy shipments for the new plants now being constructed at Alliance and Canton, O.; Iowa, Indiana, Illinois and the Southwestern States also purchased a large proportion of the stock. It was, of course, an experiment for a telephone manufacturing company to take up a distinct branch such as the pole business, but the results have been so satisfactory and worked in so well with its general business that they have decided to continue for another year. The stock is not exhausted, and the company is negotiating with those in need of this line material.

PROPOSALS FOR ELECTRICAL MACHINERY.—The London County Council, London, England, is advertising for bids on two 2500-ihp vertical steam engines coupled direct to a three-phase 1500-kw generator working at 6500 volts, each with an exciter, and for one 750-kw reversible synchronous motor-generator with exciter, and for the installation of this equipment in the generating station at Greenwich. The proposals also call for nine 300-kw synchronous motor-generators, each with an exciter, and for three 50-kw induction motor-generators for installation in sub-stations. The time for bids closes on Oct. 8. The London County Council is also inviting bids on two 2500-ihp vertical engines each coupled direct to a direct-current, 1500-kw dynamo, for installation in the station of the South London Electrical Supply Corporation. Also for three auxiliary 250-ihp vertical, high-speed, enclosed engines, each coupled direct to a direct-current dynamo, the same to be installed in the Greenwich station. This contract also closes on Oct. 8.

CATALOGUES FOR EXPORT.—The export department of the Federal Electric Company, 141 Broadway, New York, has received a request from a foreign government for catalogues, circulars and descriptive matter covering all classes of electrical material manufactured in the United States. The Federal Electric Company purposes securing as many catalogues as possible and forwarding them to its correspondents. These catalogues will be placed in the Government file, properly classified, where they will be accessible to all buyers of that country and any one else who wishes to examine them. Manufacturers desirious of being represented in this catalogue file are requested to send catalogues in triplicate to the export department of the company, and to mark on the wrapper or envelope containing the catalogues or circular matter the word "Foreign," in order that it may be known for what purpose the catalogue is sent. Mr. B. Blum is the manager.

VARIOUS ORDERS FROM BRITISH EAST INDIES.—The American electrical engineering and contracting firm of Bagnall & Hilles, of Japan, the Philippines, etc., have recently been forwarding to the United States some fair-sized orders for various electrical equipment and supplies on behalf of their Singapore offices. The Sprague Electric Company have secured a contract for motors, ceiling fans and so forth. The Perkins Electric Switch Company have obtained an order for several hundred switches. The Manhattan Electrical Supply Company, of 32 Cortlandt Street, New York, is furnishing a quantity of fuse wire, push buttons and other supplies and Bryan-Marsh & Co. have obtained an order for about 10,000 Edison base incandescent lamps varying from 5 candle-power to 32 candle-power.

PUMPING EQUIPMENTS FOR JAPAN.—Mr. T. W. Horne, an American formerly connected with the Central Railroad of New Jersey, and now established at Yokohama as an importer of American machinery for the Japanese markets, is placing some important contracts for electrical apparatus, etc., through W. J. Kingsland, 35 South William Street. The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, have secured an order from Mr. Horne for 15 pumping equipments of various sizes, which are to be used chiefly in connection with electrical work in the north of Japan.

TROLLEY CONTRACT IN ENGLAND.—A special dispatch from London of Sept. 29 says: The firm of J. G. White & Co., of New York and London, has been awarded a contract to build the corporation tramways of Bournemouth at a cost of £152,000 ($760,000). Especial interest attaches to the proposed lines for the reason that they will be the first ever constructed in Great Britain combining conduit and overhead trolley sections. The Bournemouth lines will be contsructed by an English company organized by Americans.

REDUCED TELEPHONE RATES.—The American Telephone & Telegraph Company has changed its tariffs all over the United States so that one can now use the telephone for a three-minute period as the minimum, instead of a five-minute minimum, as formerly, and has made the charge for the three-minute period about three-fifths of the five-minute period. The three-minute charge, between New York and Boston is $1.25 for day time, and 65 cents for night, in place of $2 and $1, respectively, for the five-minute period.

TRAMWAY RAILS FOR ENGLAND.—The Lorain Steel Company continues to make substantial shipments of rails for use by various British municipal electric traction systems. A shipment of 550 tons is about to be made to Halifax, Yorkshire, and three lots aggregating 1500 tons will go forward shortly to Manchester. The New York electrical engineering and contracting firm of J. G. White & Co. will forward, by first Australian steamer, some 50 tons of Lorain special track work for the Perth Tramways, West Australia.

EQUIPMENT CONTRACTS FOR YERKES' LONDON ROAD.—According to prominent London parties who are regarded as being in close touch with electric traction affairs on the other side, the Ganz system will not be adopted on the Metropolitan District Railway. The British Westinghouse Company, which has obtained the contract for the power house engines (36,000 horse-power), is now said to have been promised the contract for the motor equipment.

CARS FOR LISBON TRAMWAYS.—Barber & Co.'s steamship "Nordpol," which sailed last week for Spanish and Portuguese ports with the largest cargo—nearly 9000 tons, valued at almost $300,000—ever forwarded from this side to that part of the world, carried some 1400 tons of car material intended for the Lisbon Tramways. The shipment included 25 cars built by the St. Louis Car Company. These cars have Brill trucks and General Electric motor equipments.

PHONOGRAPHS FOR THE FAR EAST.—The Columbia Phonograph Co., of Bridgeport, Conn., is at present making some large consignments of phonographs, etc., to Far Eastern markets. Substantial lots are now waiting shipment to Reuter, Brockelman & Co., of Shanghai, which concern imports large quantities of American machinery, including electrical equipment and supplies. Shipments are also made to Heyn, Brockelman & Co., of Osaka, Japan.

CITY OF MEXICO TRAMWAYS.—The power house equipment of the Compania Limitada de Tranvias de Mexico (Mexican Tramways Company, Limited), which at present has a capacity for developing 2400 horse-power, is to be increased to 3000 horse-power in view of the extension of the company's system to Tacuba, which is located about 10 miles from the Mexican capital.

ELECTRIC RAILWAY SUPPLIES FOR SOUTH WALES.—Tenders are invited until Oct. 21 by the Corporation of Newport, South Wales, for a complete equipment of coal handling apparatus, an electric motor car and a repair shop equipment. Mr. H. F. Parshall, London, England, is consulting engineer, from whom specifications can be obtained.

THE CROCKER-WHEELER COMPANY desires to announce that after Oct. 1 its New York office will be under the management of Mr. Francis B. De Gress. Mail for this office should be addressed to the Crocker-Wheeler Company, New York branch, 39 Cortlandt Street.

ELECTRIC CRANE FOR ENGLAND.—The Brown Hoisting Machine Company, of Cleveland, Ohio, has received an order from Vickers Son & Maxim, Limited, makers of ordnance, etc., for a 10-ton electric cantilever crane.

THE GENERAL ELECTRIC COMPANY is about to make shipment of some carloads of various electrical machinery to Bagnall & Hilles, Kobe, Japan, for installation in a lighting plant in that city.

General News.

THE TELEPHONE.

EAST LAKE, ALA.—The Southern Bell Telephone Company will erect a building in which to locate the East Lake exchange.

HOPE, ARK.—The Hope Telephone Company has been sold to Lee J. Taylor.

SAN FRANCISCO, CALIF.—City Attorney Franklin K. Lane, of San Francisco, has been instructed by the Supervisors to institute new suits against the Pacific States Telephone & Telegraph Company for failing to pay license on its nickel-in-the-slot telephones. The original cases were dismissed on a technicality.

SAN FRANCISCO, CALIF.—The Freeport Telephone & Telegraph Company was recently incorporated with Courtland, Calif., as the principal place of business. Directors: William Johnson, T. W. Dean, W. J. Smith, G. B. Greene, P. G. Rhiel, L. D. Greene and H. F. Isham. Capital stock, $50,000; subscribed, $10,400.

ATLANTA, GA.—The Southern Bell Telephone Company will build a $30,000 addition to its exchange. Plans are being prepared by Bleckley & Tyler.

TREMONT, ILL.—The Independent Telephone Company is building a line from this place to Dillon.

MT. CARROLL, ILL.—The Central Union Telephone Company intends to reconstruct its lines in this city.

MONMOUTH, ILL.—Chas. C. Hook is constructing a telephone line in Warren County for the independent company.

ST. JACOB, ILL.—The Kinloch Telephone Company was granted a franchise at a special meeting of the town board.

RANTOUL, ILL.—The Rantoul Village Council refused to give the Bell Telephone Company a franchise to operate in this village.

JONESBORO, ILL.—The Jackson Union Telephone Company has changed its name to the Southern Union Telephone Company.

HENRY, ILL.—The Bureau County Independent Telephone Company is building a line between Princeton and Bureau Junction.

WOODSTOCK, ILL.—A. B. Wager has sold out his telephone exchange to a syndicate composed of Judge C. H. Donnelly, George W. Field and D. R. Joslyn.

CHICAGO, ILL.—The Neoga Telephone & Telegraph Company, Neoga, capital stock $2,500, has been incorporated by John A. Baughman, Daisy Baughman and Mamie A. Sheehan.

MORRISON, ILL.—The Whiteside Harrison Telephone Company has been succeeded by the Whiteside County Telephone Company. The new company has been organized with a capital stock of $120,000. Directors: Hon. H. H. Evans, of Aurora; F. H. Case, of Chicago; Hon. D. D. Hunt, of De Kalb; E. J. Conklin, of Joliet, and Charles Bent, of Morrison.

EL PASO, ILL.—The El Paso Telephone Company, recently incorporated, has been organized by the election of Dr. R. E. Gordon, president; Jos. Bonner, secretary and manager, and A. S. Shephard, treasurer. The company is making an effort to purchase the plant of the Peoria & Eastern Telephone Company. If it is successful in securing this property it will have 300 local subscribers, besides farm lines. If it does not purchase the Peoria Company's system it will build one of its own.

ZIONSVILLE, IND.—The Citizen's Telephone Company, capital stock $10,000, has been incorporated.

CROWN POINT, IND.—The Crown Point Telephone Company is building its new line between here and Merrillville.

ROSSVILLE, IND.—The Home Telephone Company, of this city, has been organized and incorporated; capital, $12,500. The company will extend its lines into the farming districts.

GASTON, IND.—The Central Union Telephone Company is completing a branch exchange at this place, made necessary by the demand of the farmers as well as the town. Party lines are being constructed and $1 a month will be charged.

FRANKFORT, IND.—About twenty co-operative companies, representing towns and rural districts covering practically all of western Indiana and eastern Illinois, controlling nearly 10,000 telephones, have consolidated under the name of the People's Telephone Company. Six miles of trunk line will connect the systems with this city, where connection is made with the wires of the new long-distance company of Indianapolis.

INDIANAPOLIS, IND.—The officials of the new Long-Distance Telephone Company brought 225 girl operators of the system from their posts of duty to this city last Saturday for an annual gathering and reception, with a view of making acquaintances and an exchange of ideas. The entire party was given a trolley ride and a reception and banquet at night at the Proplaeum. President Sherrin, of the company, acted as toastmaster and complimented the young women for their strict attention to the affairs of the company. A number of the young women made interesting talks along the same line. Dancing followed the banquet.

FRANKFORT, IND.—For two years, a score or more of co-operative telephone companies have been putting in telephone systems in the smaller towns and rural districts in western Indiana and eastern Illinois. Recently these systems were consolidated under the name of the People's Telephone Company, and the various systems, representing a total of 7,000 telephones in actual use, were connected. The representatives of the consolidated companies have contracted with the Central Energy Telephone Company of this city for connection with its service, and through the Central Energy to have connection with the new long-distance telephone system. This is the most important telephone deal in the State in years, and was secured by the new company after a prolonged struggle with the Bell Company.

LOGANSPORT, IND.—The granting of a 40-year franchise to Thomas Thorwood, of Ft. Wayne, and Walter J. Uhl, of Logansport, by the City Council, empowering them to construct and operate a telephone system in Logansport has ended a long and bitter contest. The citizens insisted upon having but one telephone system, and at the expiration of the Bell Company's franchise next January the new company will have a clear field. The new franchise provides for a restriction in rates to $15 per annum for residence and $25 per annum for business houses until one thousand individual telephones are in operation, when the business rate may be increased to $30.

OTO, IOWA.—A new telephone system is among the possibilities for Oto.

MISSOURI VALLEY, IA.—Another rural telephone line is being built to Keiffer, of Hanover, Pa., is secretary.

MARTINSBURG, IA.—J. T. Brooks and L. L. Bollin, of Hedrick were in town looking after the interests of the new telephone line which will soon be completed to Hayesville.

AFTON, IA.—The Afton Mutual Telephone Company, whose incorporation was recently noted in these columns, is using Kellogg equipment throughout. Its switchboard has a capacity of 150 lines. It has eight miles of toll line to Orispe, and will at once build a line to the north, a distance of twelve miles.

DES MOINES, IOWA.—Judge S. F. Prouty, in the district court here, decided against the Iowa Telephone Company, holding that it is a trespasser in the streets of the city, because it has no franchise. The Mutual Telephone Company, the Iowa's rival, brought suit to oust the latter. The Iowa Company's defence was that it did not require a franchise to use the streets of the city because the streets are highways, and the company is authorized by the State law to use the highways for its poles. Judge Prouty holds that the streets of a city are not highways, and that the city has a right to restrict their use for telephone purposes, though the telegraph companies have a right to use them without franchises, since they do not do so to the extent as do telephone companies, but come on railway right of way. The Iowa company will appeal, its attorney being confident of securing a reversal.

RICHMOND, KY.—Work on the telephone line between Berea and Livingston, via Wildie and Conway, will soon be commenced.

COVINGTON, KY.—The Cincinnati Telephone Company, capital stock $10,000, has been incorporated by J. H. Becker and Peter Knadley.

HODGENVILLE, KY.—The Cumberland Telephone Company will at once begin the construction of a telephone line from this place to New Haven, Ky.

LOUISVILLE, KY.—The joint committee on contracts has voted to make a recommendation to the general council to reject a contract made between the city and the Cumberland Telephone & Telegraph Company, whereby this company was to be paid $11,000 for placing the fire and police wires in underground conduits. The Home Telephone Company has offered to do the work for a much lower figure. It is said that the city will of necessity have to do something to improve its fire alarm system.

JENNINGS, LA.—The Cumberland Telephone Company is putting in a new exchange at this place.

SHREVEPORT, LA.—The Shreveport City Council granted permission to M. D. Shaw the right to construct and operate a new telephone system in Shreveport.

HAGERSTOWN, MD.—Hanover, Pa., parties have bought a controlling interest in the Maryland Telephone Company and will extend its lines to Martinsburg and Shepherdstown also into Virginia and Pennsylvania. John K. B. Keiffer, of Hanover, Pa., is secretary.

FALL RIVER, MASS.—The Fall River Automatic Telephone Company has comenced operating its exchange with a portion of its subscribers, and is adding to the number as fast as telephones can be put in and connected by the present gang of workmen. New applications for the automatic service are coming in freely on account of the satisfaction given. The Strowger automatic telephone system is used, the same system as that installed in New Bedford some months ago, but with important improvements.

ELMDALE, MICH.—The Citizen's Telephone Company has its lines nearly completed to this place from Saranac.

DETROIT, MICH.—The Livingston County Telephone Company has been granted a franchise by the Village Council of Brighton. This is the new independent company organized to compete with the Bell Company in Livingston county.

MINNEAPOLIS, MINN.—The Stevens County Telephone Company, of Morris, has filed articles of incorporation. The incorporators are C. R. C. Johnson, H. L. Hulbert, George F. Darling and George F. Darlicy, of Morris. The company has a capital stock of $10,000.

MINNEAPOLIS, MINN.—Direct telephone communication between Minneapolis and Winnipeg will be established within a month by the Bell Telephone Company of Canada operating in connection with the American Bell Company whose lines now reach as far north as Neche, N. D.

MINNEAPOLIS, MINN.—The Northland Telephone Company has been incorporated here with a capital stock of $25,000. It will be a long-distance associate of the Zenith Telephone Company, the local independent line, and it proposes to give service to the iron range and the surrounding country, including a connection with the Consolidated Telephone & Telegraph Company, which will give independent connection with the twin cities.

CLINTON, MO.—The Mutual United Telephone Company, capital stock $15,000, has been incorporated by G. Lingle, S. T. Neill, W. F. Hall and others.

ST. LOUIS, MO.—The Capital Telephone Company, of Jefferson City, has purchased the telephone line formerly operated between Jefferson City and Hickory Hill. It will be made a part of the local system of Jefferson City.

ST. LOUIS. MO.—The Arizona & New Mexico Telegraph Company, capital $15,000, has been incorporated, with headquarters at Clifton, Ariz. Incorporators and directors: James Colquhoun, Harwood J. Simmons, Alexander Veitch, Mark J. Egan and George Frazer, all of Clifton. The company intends to build a telegraph and telephone line from Clifton to Lordsburg and to Hachita, either with wires or without wires.

RALEIGH, N. C.—The Interstate Telephone Company will install a new switchboard and make other improvements in its exchange.

WINSTON-SALEM, N. C.—The Bell Telephone Company has completed connections with this town, thus giving a long-distance service.

WOODSTOWN, N. J.—The Interstate Telephone Company has made application to the Borough Council for franchise privileges.

JERSEY CITY, N. J.—The Wireless Telegraph Company of America has been incorporated here; capital, $3,000. Incorporators: Lee De Forest, Clarence E. Freeman, Edwin H. Smythe, Charles Siedler, M. F. Stires, Jr.

NEW YORK, N. Y.—The New York & New Jersey Telephone Company has purchased the Barnes mansion at Clinton and Atlantic Avenues, Brooklyn.

ROCHESTER, N. Y.—The Canandaigua Board of Trustees has granted a franchise to the Inter-Ocean Telephone & Telegraph Company for the establishment of an exchange in Canandaigua with privileges of erecting poles and stringing wires.

ALBANY, N. Y.—The New York State Telephone Company has been incorporated, with a capital of $2,500,000, to operate in Buffalo. The directors are William D. Barnard, of St. Davids, Pa.; Henry Shafer, of Chicago; Richard G. Park, of Westchester, Pa.; C. M. Clement, of Sunbury, Pa.; William F. Mackey, of Buffalo; Edward Davis, of Philadelphia, and Ward R. Bliss, of Chester, Pa.

ALBANY, N. Y.—The Frontier Telephone Company was incorporated on Sept. 30 with a capital of $500,000 to connect by telephone Buffalo, New York City and intervening places and Cleveland, Ohio. The directors are Irving A. Stearns, of Wilkesbarre, Pa.; Alvan Markle, of Hazleton, Pa.; James M. Thomas, of New York City; E. C. Lofkin, John B. Weber and Charles B. Hill, of Buffalo, and Frederick R. Green of Fredonia.

MIDDLEPORT, N. Y.—The new exchange of the Home Telephone Company has been in operation for a couple of weeks. The Home Company now has a larger number of subscribers than the Bell Company and the list is constantly growing. The Home Company will use the toll lines of the Middleport Telephone Company for the nearby towns for awhile. There are now three telephone exchanges here.

BOLIVAR, N. Y.—Steps have been taken by prominent men of this place for the formation of a local telephone company to operate independently of the Bell interests. As yet the organization has not been completed, but everything thus far is decidedly in its favor. It is expected that long-distance connections will be made at Wellsville through the toll lines of the Inter-Ocean Telephone & Telegraph Company. This will put Bolivar into communication with a large portion of the State and be a valuable service for the Bolivar merchants.

GREENSPRING, OHIO.—The Greenspring Telephone Company has increased its capital stock from $8,000 to $15,000.

NEW LEXINGTON, OHIO.—The Central Union Telephone Company has been granted a franchise to operate an exchange and toll line.

COLUMBUS, OHIO.—Among the large cities in Ohio having independent telephone service more extensive than that of the Bell Company is Columbus. The Citizen's Telephone Company of this city has about 5000 subscribers to the Bell's 2500.

DAYTON, OHIO.—The publisher of a Dayton daily paper has completed arrangements with the local telephone company by which the suburban subscribers of the paper are to be supplied with the latest news over the wire at 7 P. M. daily.

CLEVELAND, OHIO.—The Consolidated Telephone Company, through G. H. Ginther & Company, investment brokers, of Cleveland, is offering for subscription bonds of the company to the amount of $382,000, covering the exchanges now in operation, and those nearly ready in New York State. In a prospectus just issued the properties are described in part as follows: At Ithaca the Consolidated Telephone Company has just purchased an automatic system with 125 telephones in operation, with rates of $36 for business and $24 for residences. This plant is to be remodeled at once with a complete central energy system. It is anticipated that there will be 800 to 1000 subscribers in this town at an early date. Ithaca will make an exceedingly good long-distance town, as three-fourths of the students at Cornell University live in central and western New York, and will use the long-distance lines. The exchange at Hornellsville is in operation with 500 subscribers, as against the Bell Company with less than 200. The Corning exchange is in operation with 650 subscribers, half of whom are connected at the present date. The Wellsville exchange will be in operation in the very near future with 125 subscribers connected. The Valley Telephone Company, which will operate in Waverley, N. Y., and Sayre and Athens, Pa., is being constructed, and there is every reason to believe this will be a very profitable exchange. The amount of bonds to be issued on the plants mentioned will be approximately as follows:

	No. of Telephones.	Total bond issue.
Hornellsville	800	$40,000
Corning	800	60,000
Wellsville	300	22,500
Waverley, Sayre and Athens (Valley Telephone Co.)	800	60,000
Watkins	300	22,500
Bath	200	15,000
Ithaca	800	72,000
Inter-Ocean Telephone & Telegraph Company (Long Distance)	200 miles.	90,000
		$382,000

The securities are 6 per cent., 20-year gold bonds. They will be redeemable at any interest bearing period after five years from date at 105. There is also a sinking fund provision amounting to 2½ per cent. per annum upon the total amount of bonds issued and outstanding, except as to Hornellsville, where the bonds will be redeemable ten years from date. The bonds are to be sold at 95 per cent of par value, 25 per cent payable upon execution of bond and the balance in three monthly installments.

CLEVELAND, OHIO.—The Columbus Citizens Telephone Company, which has been in operation about a year, is already on a dividend paying basis, and is proving one of the most promising of the properties of the Federal Telephone Company. The statements for July and August and for the first eight months of 1901 are as follows:

	July.	August.	Eight months.
Gross earnings	$13,155.18	$13,667.38	$99,105.07
Operating expenses	6,177.95	6,580.31	46,575.22
Net earnings	6,977.23	7,087.07	52,529.85
Surplus	4,685.57	4,795.41	34,867.77

LAWTON, OKLA.—People are opposing the building of a telephone system until there is a city government to sell a franchise.

WASHINGTON, PA.—Permission was granted to the West Penn Telephone Company to erect poles in the borough.

HARRISBURG, PA.—It is announced that the United Telegraph & Telephone Company has obtained control of the Southern Telephone Company, which operates a system in Cumberland, York, Adams and Franklin counties, and that the acquired lines will be connected with the system being installed in this city.

HARRISBURG, PA.—The Cumberland Valley Telephone Company has been organized at Harrisburg, with the Dauphin County Telephone Company, the Southern Pennsylvania Telephone Company, the Cumberland Valley Telephone & Telegraph Company, the Hanover Telephone Company and the Adams County Telephone Company as the underlying and constituent companies. The new company will have its headquarters in Harrisburg. The principal officers are B. F. Meyers, of Harrisburg, president; W. B. Barnard, Philadelphia, vice-president; Frank E. Ziegler, Harrisburg, secretary, and S. L. John, McSherrystown, treasurer.

MITCHELL, S. D.—The Faldreau Telephone system is being enlarged and improved.

COLTON, S. D.—The citizens of Colton have decided to put in a local telephone system, which will be extended to adjoining farms.

ALEXANDRIA, S. D.—The Fairview Telephone Company has been incorporated with a capital stock of $2,000, by F. A. Gregory, N. Van Tassel and Wm. Newman.

WOODBURY, TENN.—A telephone exchange is being put in at Woodbury.

DECATUR, TENN.—The Meigs County Telephone Company will extend its lines, about ninety miles of wire having been bought for the purpose.

CHATTANOOGA, TENN.—The East Tennessee Telephone Company has purchased the Rockwood telephone system. Connection will at once be made with all long-distance systems.

TERRELL, TEX.—A new telephone line between this city and Crandall has been completed and put in operation.

CALVERT, TEX.—E. D. Atkinson is organizing a company to establish a telephone system between Calvert and Mayfield.

BONHAM, TEX.—At a meeting of the Electric Railway Company the recent franchise tendered by the city was accepted and work began at once. The line will traverse all principal business and residence streets.

AUSTIN, TEX.—The independent telephone movement in Texas is having a rapid growth, and it will be but a short time until the exchanges and toll lines of the Lone Star Telephone Company, which is at the head of several projects, will cover the State. Exchanges are already in operation at San Antonio, Waco and Houston and are in process of construction at Austin, Temple, Corsicana, Taylor and a number of other places. Toll lines have been built connecting the southern points in Texas with Indian Territory and Arkansas points and an eastern line is now being built to New Orleans by way of Galveston and Beaumont.

RICHFIELD, UTAH.—The Bell Telephone Company will not build its line from Mt. Pleasant to Scofield until spring.

SALT LAKE CITY, UTAH.—Salt Lake City will soon have telephonic connection with San Francisco, Chicago, New York, and other Eastern cities. The completed line from San Francisco to the East will cover a distance of 4500 miles. This long circuit will be made possible by the closing of the gap in North Dakota and Montana by the Rocky Mountain Bell Telephone Company and the Northwestern Company. The first named company will build eastward from Billings, Mont., to the boundary line between Montana and North Dakota, a total distance of 200 miles, and the Northwestern Company will build west from Bismarck, N. D., to meet the extension from the West.

WYTHEVILLE, VA.—The farmers in the surrounding county are discussing a proposition looking to the establishment of a mutual independent telephone system similar to one operated in Augusta County.

PETERSBURG, VA.—A telephone line is to be built between Petersburg and Prince George County Courthouse by a company soon to be organized. The company will be composed of citizens of Petersburg and Prince George County.

MILWAUKEE, WIS.—The Wisconsin Telephone Company reports a net gain of 235 subscribers in August, making a total number of 22,505 subscribers on Aug. 31.

ASHLAND, WIS.—For the first time in twenty-two years, the toll line service of the Wisconsin Telephone Company in Wisconsin was suspended on the afternoon of Sept. 19. The order went out that from 2:35 until 2:40, Eastern time, the 600 odd toll line stations in the State should be silent, during the time that the burial of the President was actually taking place at Canton, Ohio. This made the system silent in Wisconsin between 3:35 and 3:40 o'clock.

ELECTRIC LIGHT AND POWER.

VANCOUVER, B. C.—The British Columbia Electric Railway Company has decided to install a water-power plant at Coquitlam Lake, 20 miles from Vancouver. Mr. Horne-Payne, who has already invested £900,000 in British Columbia, has organized the company in England to construct and operate the plant. The company will be known as the Vancouver Power Company. A tunnel will be driven through a mountain separating Lake Beautiful from Coquitlam Lake, a distance of two miles. Fifteen thousand horse-power is available. The plant will cost $500,000, but maintenance will not be over $15,000 a year for 5000 horse-power, which is about what will be needed.

ASHBURN, GA.—The Southern Electric Supply Company, of Macon, Ga., has completed an electric light plant for J. S. Betts & Company, for use in their mills and stores. Later the lights will be extended to other portions of the town.

KOKOMO, IND.—This city is completing a new modern electric light and water works plant.

FORTVILLE, IND.—The Town Council has granted a franchise and entered into a contract with I. N. Slabler, of Fairmount, giving him a 25-year contract for an electric light plant.

OTTUMWA, IA.—The Ottumwa Electric & Steam Company has been reorganized under the name of Ottumwa Traction & Light Company.

NEW ORLEANS, LA.—Arrangements are now being completed for the removal of the offices of the consolidated company, including the Carrollton Railroad Company, the Edison and the Merchants Electric Companies, into the Edison Electric building on Baronne Street. Officers have been elected as follows: Mr. J. K. Newman, president; Jos. H. DeGrange, vice-president; W. V. Crouch, secretary, and W. B. Bockway, assistant secretary. The official name of the consolidated concern is the New Orleans & Carrollton Railroad, Light & Power Company. The charter, which has been prepared, sets forth that the capital stock is $7,500,000.

BANGOR, MAINE.—The water-power plant of the city electric lighting station has been shut down, and from now until the new lighting equipment is ready for use the machinery will be operated by steam power. The new wheels are four in number—three of them 57-inch and one 33-inch, and they will replace three old wheels. They will develop, at minimum head of water, about 450 horse-power, and at ordinary head about 1000 horse-power, and there will also be installed a 450-horse-power steam engine. New electrical equipment will be installed.

NORWAY, MICH.—M. Spitzer has completed plans for an electric light plant, to be built in connection with a pumping station for the city of Norway. It will cost $22,000.

MARQUETTE, MICH.—The Electric Light and Power Commission, which controls the municipal electric light plant, has decided to abandon its flat rate and insist on the general installation of meters in the buildings of all light consumers, the power business remaining on the present basis.

McINTOSH, MINN.—The village Council at its last regular meeting granted to Mr. Anton Jensen a ten-year franchise for an electric light plant, to be completed by Jan. 1, 1902, the Council reserving the right to purchase the said plant at the end of five, eight or ten years.

ST. LOUIS, MO.—The preparations for the installation of electric power instead of steam in the immense Anheuser-Busch brewing plant are well under way. The power-house is being built. The brewery intends to do away with all its 24 steam engines and to install motors and dynamos in their places. The power equipment when completed will consist of four generators of 500-kw capacity each, which will be run by four 800-hp upright engines. The total capacity of the plant will be 3000 horse-power. The outlay for the introduction of electricity will be very heavy, but an immense saving will be made. Half of the new power plant is expected to be ready for occupation by Jan. 1.

ST. LOUIS, MO.—The Citizens' Electric Light & Power Company has applied for permission to lay conduits on several streets in St. Louis. It has also bought property at the foot of O'Fallon Street, and has plans ready to begin the erection of a large power plant. The Citizens' Company was organized about five years ago, with a capital stock of $3,000,000, and a second payment of the stock has been called for. The company will begin at once an aggressive campaign to get contracts for lighting and power. The company is composed of practically the same stockholders as the Kinloch Telephone Company and the Kinloch Long-Distance Company. The officers are: Julius S. Walsh, president; August Gehner, first vice-president Rolla Wells, second vice-president; Breck. Jones, treasurer; Philip Stock, secretary; W. Roy McCanne, assistant secretary, and Chas. H. Ledlie, general manager and chief engineer. The directors are, with the above: Chas. H. Turner, Sam M. Kennard, Adolphus Busch, W. J. Lemp, C. Marquard Forster, William F. Nolker and Henry Nicolaus.

TRENTON, N. J.—The Phœnix Gas & Electric Company, capital $1,000,000, has been incorporated by William D. Lippincott, Walsh Banyard and David Rambold.

NEWARK, N. J.—Howard W. Hayes, counsel for the National Electric Light, Heat & Power Company, has applied to Chief Justice Depue for a writ of certiorari to have reviewed the action of the Orange Common Council in awarding the lighting contract to the United Electric Company. The bid of the National Company was $15 per lamp lower than the bid of the company which got the contract.

ITHACA, N. Y.—The plant of the Dolgeville Electric Light & Power Company was sold in Herkimer recently to satisfy mortgages. Richard L. Storrs, representing the Herkimer County Electric Light & Power Company, bid in the property for $20,000. The purchase includes Dolgeville and Little Falls franchises and the Herkimer Company will operate the plant in connection with its present business.

COLUMBUS, OHIO.—The city of Columbus has called for bids on electric street lighting. The Columbus Electric Company, the only company in the field, has offered to bid on 650 lamps, but the city wants only 600 lamps.

MARION, OHIO.—The Marion Electric Light & Power Company held its annual meeting last week and elected directors as follows: E. Huber, E. Durfee, G. W. Kling, C. W. Leffler, C. Harraman, W. L. Warner and H. Strelitz. Officers: C. W. Leffler, president, manager and treasurer; E. Huber, vice-president; H. Strelitz, secretary. The annual report showed the company had had a very successful year.

CINCINNATI, OHIO.—The electric float of the night pageant during the second week of the Fall Festival, which ended Saturday night, Sept. 28, was the feature of the parade. It was the result of several months' arduous labor on the part of A. C. Beattie, of the Lawton-Beattie Electric Company and others representing the General Electric, the Standard Electric Company, and Post-Glover Electric Company. The float was in the shape of a huge ball studded with hundreds of vari-colored 8-candle-power incandescent lamps in fanciful designs, which revolved as the float moved. The power came from the overhead trolley system of the Traction Company. All the floats in the pageant were lighted in this manner.

HARRISBURG, PA.—The People's Steam, Heat & Power Company, of Easton, Pa., has been incorporated, with a capital stock of $1,000.

HARRISBURG, PA.—The Schuylkill County Electric Company, of Pottsville, and the Corry Electric Light & Power Company, of Corry, have been incorporated, each with a capital stock of $10,000.

PITTSBURG, PA.—Negotiations are now on foot and may be closed any day, which will form a combination of all the electric traction, power and lighting interests of Allegheny County, aggregating a capitalization in stocks and bonds of $106,800,000. The companies to consolidate are: The Philadelphia Company, which distributes natural gas throughout this section, and which is the largest company of its kind in the world; the Consolidated Traction Company, with 112 miles of street-car tracks; the United Traction Company, with 117 miles; the Birmingham Traction Company, 28 miles; the Monongahela Street Railway, 28 miles; the Allegheny County Light Company, and the Monongahela Electric Light & Power Company.

THREE RIVERS, QUE.—The Three Rivers Gas, Heat & Power Company has been incorporated.

SIOUX FALLS, S. D.—The new city electric light system has been placed in operation over a considerable portion of the city, and works to perfection. The present down town, or business district, now lighted by the Cascade Milling Company, will be continued under the direction of the company until the city authorities can arrange for the new lights in that part of the town, but in the course of a few days the entire system will be controlled by the city.

COOPER, TEX.—The Cooper Electric Light Company has been succeeded by the Cooper Electric Light & Manufacturing Company.

SALT LAKE CITY, UTAH.—The Mary M. mine, of Provo, Utah, will be equipped with electric machinery, including pumps, drills and hoist.

SALT LAKE CITY, UTAH.—The American Falls Power, Light & Water Power Company filed its articles of incorporation at Pocatello, Idaho. The company is capitalized for $300,000. All the stock has been subscribed. The directors are J. H. Brady, D. W. Standrod, A. F. Caldwell, all of Pocatello, and R. Rounds and A. B. Scott, of Idaho Falls. The principal place of business will be Pocatello. The purposes for which the company is organized is twofold; the utilizing of the power of the Snake River at American Falls, to generate and transmit electrical energy, primarily for Pocatello, and the construction of canals for irrigating the lands around American Falls. President Brady stated that work on the power plant will commence within thirty days, and that by July next year he will have the power into Pocatello. It is understood the Oregon Short Line Railroad will be a heavy consumer of this power, as the plans for the new shops to be built there contemplate the use of electric motors instead of steam power.

SPOKANE, WASH.—Articles of incorporation were filed by the Wallace Light & Water Company of Spokane, with a capital of $125,000. The incorporators and trustees are E. J. Dyer, president of the Exchange National Bank; Robert E. Strahorn, real estate, and Attorney R. J. Danson.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—In connection with the consolidation of the Mobile Street Railway Company and the Mobile Light & Railway Company under the name of the Mobile Light & Railway Company, it is stated that improvements to the extent of $500,000 are projected. W. H. Patterson, of Atlanta, was elected president of the new company. Nearly half of the new capital is Atlanta money.

FRESNO, CALIF.—The Fresno City Railway Company has been incorporated with an authorized capital stock of $500,000. It will construct an electric street railway system 43 miles long.

LOS ANGELES, CALIF.—The Los Angeles and Pasadena Electric Railway Company will make extensive improvements, and put in a new engine and machinery, to the amount of $15,000 before Jan. 1.

LOS ANGELES, CALIF.—The owners of the Temple Street Cable Railway of this city have decided to adopt electricity as the motive power of the line and a new electric plant will be installed at a cost of $60,000 to $75,000.

HARTFORD, CONN.—The project for a through street railway line from Hartford to Worcester, sixty miles, and ultimately to Boston, is making progress. The Stafford Springs Street Railway Company, which recently secured a franchise to operate a trolley line from Rockville through various towns and villages to the Massachusetts State line at Monson, has organized, and is prepared to build as soon as preliminary details are adjusted.

ATLANTA, GA.—Attorneys of the Atkinson corporations on Sept. 23 gave out a statement regarding the rumored consolidation of the local electric railway interests. The statement in part says: "A conditional trade has been entered into by which certain financial concerns have agreed to purchase the stock and bonds of the Atlanta Railway & Power Company, held by Mr. Hurt and associates in Atlanta. This trade is proposed to be consummated to-morrow

(Sept. 24) in Baltimore. It is not the purpose of this trade to consolidate the two companies."

CHICAGO, ILL.—The Citizen's Electric Street Railway of Chicago, of which Price McKinney, of Cleveland, is chief financial backer, will ask for a franchise from the City Council of Chicago for a line on Jefferson Street through the center of the city.

LA PORTE, IND.—The Michigan & West Shore Traction Company has filed articles of incorporation, with a capital stock of $1,350,000.

INDIANAPOLIS, IND.—Track-laying has begun on the Indianapolis and Martinsville line between this city and Mooresville. The grading and bridge building is progressing on the last division.

CHESTERFIELD, IND.—The electric road has practically ruined the passenger traffic of the steam road out of this city. The station maintained here since 1852 has been abandoned by the steam road.

GREENFIELD, IND.—The Indianapolis & Greenfield Interurban Company is distributing material for the extension of its line from this city to Knightstown. The work is to be finished within two months.

ELWOOD, IND.—The Union Traction Company is now distributing the steel rails for the laying of its tracks between this city and Tipton, and the new branch of the large system will be in operation by the first of the year.

NOBLESVILLE, IND.—The Central Traction Company of Indiana will open bids for the construction of a line from this city to Indianapolis and way points. The company has opened an office in this city and the construction will be pushed. Mr. Stillwell, vice-president, says the grading will all be done this year and the Tipton division put in operation.

MARION, IND.—An important deal in interurban roads has been made here whereby the Union Traction Company acquired the property of the Marion Transit Company, thus ending one of the most interesting fights that has taken place between interurban roads in the State. President McCulloch, of the Union Traction Company, decided to end the war by purchasing the competing line.

INDIANAPOLIS, IND.—The Ft. Wayne & Lima Traction Company, with a capital stock of $50,000, has been incorporated. The company is composed of the following citizens of Lima, Ohio: D. J. Cable, J. B. Kerr, W. F. Numan, W. L. Parmenter and Henry W. Neff. It will operate a street railway system in Ft. Wayne and proposes to construct an interurban line from Lima, Ohio, to Ft. Wayne.

RICHMOND, IND.—The Hamilton, Eaton & Richmond Traction Company has incorporated its central division with a capital of $200,000, which is to be increased to $750,000. The company will build an interurban railway from Hamilton, Ohio, to this city and other points in Indiana. The following officers were elected: President, John J. Hall; vice-president, G. M. Hodges; secretary, O. F. Dillman.

INDIANAPOLIS, IND.—A great interurban system is being planned to connect manufacturing centers with the Indiana and Illinois coal fields. Columbus, Ohio; Anderson and Indianapolis, Terre Haute, Ind., and Danville, Ill., are to be included in the system. The first practical efforts to develop the plan is now being made at Danville. The syndicate controlling the local street car system owns the street car plants at Ft. Wayne, Lafayette, Champaign, Urbana and Quincy. The syndicate is extending its line to Georgetown through the heart of the coal fields. It is believed that the Ohio, Indiana and Illinois idea will be carried out. The lines which can be easily connected and consolidated for the great system are rapidly filling up with manufactories and residences.

WORCESTER, MASS.—The Worcester Consolidated Street Railway Company has in operation on the Worcester & Suburban line a new system of telephones. There is a telephone at every switch between Worcester and Spencer. Every car run on the line is equipped with a little box containing the transmitter and other apparatus.

BALTIMORE, MD.—The executive committee of the United Railways and Electric Company has decided to extend its Dundalk line to Sparrows Point and to push the work so as to complete it speedily. The Dundalk, Sparrow's Point & North Point Railway Company was recently incorporated for this new work, and it was organized with the following directors: George R. Webb, W. S. Franklin, Wm. A. House, John B. Ramsay, E. L. Bartlett, George C. Jenkins and Henry A. Parr. Mr. Webb was chosen president, and Mr. House vice-president and general manager. The other officers are Mr. Briggs C. Keck, treasurer, and Mr. H. C. McJilton, secretary. The capital of the new company is $250,000.

DETROIT, MICH.—The Detroit & Toledo Shore line, a link in the Everett-Moore electric system between Detroit and Cleveland, has filed a trust mortgage which secures the gold bonds issued for the completion of the road. A part of the issue will be floated in Detroit and a portion in the east. The road will be running by Nov. 15.

PLAINFIELD, N. J.—The necessary signatures having been obtained for the right of way over the proposed trolley line from this city to South Plainfield, it is expected that the road will be constructed at once.

DUNKIRK, N. Y.—It is proposed to extend to this city the new electric railway now building between Buffalo and Angola. The distance from here to Buffalo is 41 miles.

CANANDAIGUA, N. Y.—Officers of the Ontario & Wayne Traction Company, which was recently incorporated at Albany, have been elected as follows: John Raines, president; J. L. Burnett, secretary, and J. H. Pardee, treasurer and manager. The company's line will extend from this place to Pultneyville, on Lake Ontario.

YOUNGSTOWN, OHIO.—The Park & Falls Railway, of Youngstown, is making numerous improvement on its line.

COLUMBUS, OHIO.—The Columbus & Southern Railway has obtained a 25-year franchise from the Franklin County Commissioners.

CLEVELAND, OHIO.—In about five weeks the Western Ohio Railway will be in operation from Lima to Minister, a distance of 34 miles.

SPRINGFIELD, OHIO.—The Little Miami Traction Company has been granted a franchise over a new right of way into the center of Springfield.

CLEVELAND, OHIO.—E. P. Roberts & Company, engineers for the Southern Michigan Traction Company, will shortly place contracts for the construction work.

CINCINNATI, OHIO.—On Oct. 1 350 conductors on the Cicninnati, Covington & Newport Street Railway received an increase of wages from 18 to 19 cents an hour.

CINCINNATI, OHIO.—The Cincinnati Traction Company has inaugurated a new departure in the counting of its fare receipts. This will be done hereafter entirely by women.

TOLEDO, OHIO.—The Toledo & Indiana Railway has placed a contract with the Cambria Steel Company for about 35,000 tons of steel rails for the line between Toledo and Bryan.

CLEVELAND, OHIO.—M. J. Mandelbaum, just returned from New York City, denies that he has made any recent purchases in the stock of the Mineola, Hempstead & Freeport Railway, Long Island.

STEUBENVILLE, OHIO.—The Belmont County Commissioners have finally granted a franchise north from Martin's Ferry to the Steubenville, Mingoe & Ohio Valley Railway Company, which will build an extension.

TOLEDO, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway has obtained all right of way between Toledo and Lima and much has been secured between Bellefontaine and Columbus. Work will start Oct. 1 on track laying between Lima and West Minister.

NEWARK, OHIO.—The County Commissioners have granted the Columbus & Granville electric railway a franchise to construct an electric line from the north corporation line through Chatham and Utica to connect with a line to be built to Mt. Vernon. Mr. F. M. Black is secretary of the company.

COLUMBUS, OHIO.—Construction work on a number of extensions to lines of the Columbus Railway Company has been stopped and 300 men thrown out of work. Inability to secure deliveries of grooved rails, such as are required by its franchise, and delay in securing new cars are the causes of the difficulty.

DEFIANCE, OHIO.—It is claimed that prospects for the building of the Defiance, Ottawa, Kenton & Columbus Interurban Railway are now very bright. The road is promoted by H. A. Fisher, D. J. Ryan and others of Columbus, and it is stated that a right of way from Defiance to LaRue, a distance of ninety miles, has been secured and the line surveyed.

CLEVELAND, OHIO.—The Detroit & Toledo Shore Line, one of the properties of the Everett-Moore syndicate, has executed with the Detroit Trust Company as trustee a mortgage covering the line from Toledo to Trenton, Mich., for $2,500,000 to cover 5 per cent. bonds to be issued for the completion of the road. A portion of these bonds will be floated in Detroit and a portion in the East. Cars will be running between Toledo and Detroit by Nov. 15.

CLEVELAND, OHIO.—Stockholders of the Lorain & Cleveland, Sandusky & Interurban, Sandusky, Norwalk & Southern and Toledo, Fremont & Norwalk railways met in Cleveland Sept. 20 and ratified the actions of the directors of the various companies in an agreement to consolidate the properties into the Lake Shore Electric Railway. The new company will have a capital stock of $6,000,000 and will operate 160 miles of road between Cleveland and Toledo. It is stated that through cars will be placed in operation by Oct. 15.

CLEVELAND, OHIO.—The Pomeroy-Mandelbaum syndicate has closed contracts for equipment to provide for the Norwalk extension of the Cleveland, Elyria & Western Railway and for the Cleveland & Southern Railway. Seven Westinghouse transformers of 300 kilowatt capacity each have been ordered for sub-stations to be built at Berlin Heights and Medina. Current will be furnished from the new power station at Elyria, and this will be enlarged considerably to take care of the additional mileage. Contracts have been closed for twelve Kuhlman cars of the largest size, to be fitted with Peckham trucks and Lorain motors.

CLEVELAND, OHIO.—The incorporation of the Lake Shore Electric Railway has been recorded at Columbus. The capital stock of the new company is $6,000,000, of which $4,500,000 is common and $1,500,000 5 per cent. preferred. The directors are Barney Mahler, J. B. Hanna, H. A. Everett, E. W. Moore, C. H. Stewart, J. B. Hoge, W. J. Gawne, W. H. Price, all of Cleveland, and J. H. Harding, of Philadelphia. The consolidated company will deliver to the Western Reserve Trust Company as trustee, a mortgage covering all its property and franchises and an issue of bonds aggregating not more than $6,000,000 will be made.

CLEVELAND, OHIO.—The general managers of the various electric railway properties of the Everett-Moore syndicate met in Cleveland recently and drew up articles for the organization of the Everett-Moore Managers' Association. It is the intention to meet every two weeks at Cleveland, Detroit or Toledo to discuss different matters of common interest. Standard methods of handling the properties will be adopted and a standard set of rules for handling employes will be one of the first steps taken. It is believed that these frequent conferences, together with inspections of the different properties, will tend to improve the service greatly.

CLEVELAND, OHIO.—The Cleveland Construction Company, which is building the Little Miami Traction line, is placing contracts for the equipment of the road. It has contracted for a temporary equipment of two alternating current motors and two 300-kw rotary transformers. There will be a storage battery station of appropriate capacity. Contracts have been closed with the Jewitt Car Company for eight passenger coaches, two baggage and one work car. They will be fitted with Christiansen air brakes and will have four 60-hp Westinghouse motors. The road will be in operation between Springfield and Xenia early next year, and it is the intention to extend it to Cincinnati.

SCRANTON, PA.—The Central Rapid Transit Railway Company, which several months ago applied to Councils for the right to lay its rails on certain streets of the city and was refused the privilege, has renewed its petition and offered the city $12,000 for the franchise.

GREENVILLE, S. C.—It is believed by some that the proposed electric railway from Greenville to the cotton mill town of Piedmont will be later extended to Belton, and thence to Anderson.

TACOMA, WASH.—The Tacoma Railway & Power Company is preparing to extend the Tacoma street railway system in the southern part of the city.

SEATTLE, WASH.—The Seattle City Railway and Leschi Park have been sold to James S. Goldsmith for $500,000. Mr. Goldsmith represents the Seattle Electric Company.

NEW INDUSTRIAL COMPANIES.

THE BROOME COUNTY ELECTRIC COMPANY, of Binghamton, N. Y., has been incorporated; capital, $100,000. Directors: F. J. Sands and D. R. Buckley, of Unadilla, and S. D. Kane, of Binghamton.

THE GRAHAM-FOX MOTOR COMPANY, of New York City, has been incorporated to manufacture motors and automobiles; capital, $500,000. Directors: Frank A. Fox and David F. Graham, Stamford, Conn.; James J. Thornley, Jr., Brooklyn; C. G. Weaver, New York City, and W. D. Blake, Richmond Hill, L. I.

OBITUARY.

MR. E. P. GLEASON.—Elliott Perry Gleason, a well-known inventor and manufacturer, died at his home in Brooklyn on Sept. 26 in his eighty-first year. Mr. Gleason was born in Westmoreland, N. H. At the age of fifteen he moved to Boston, and afterward to Providence, where, in 1851, he went into business under the firm name of Mooney & Gleason in the manufacture of gas burners and similar supplies, which at that time was a new industry. Mr. Gleason perfected the Argand gas burner, which netted him a fortune. He also invented the two-hole or fish-tail gas burner tip and numerous other valuable improvements. In 1861 he established himself in New York City, where in 1871 he incorporated the E. P. Gleason Manufacturing Company. He also owned the Gleason Knitting & Manufacturing Company of Seneca Falls, and was the principal owner of the Gleason & Bailey Company, also of Seneca Falls, in which village he was known as the "workingman's friend." He was also president of the Gleason-Peters Air Pump Company, the Lawler Water Feed & Damper Regulator Company, and the Steam Boiler Equipment Company, of New York. In 1883 he began, in Brooklyn, the manufacture of glassware for illuminating purposes. He was one of the first to see the merits of electricity as an illuminant and the Gleason Company under his initiative has brought out a great many specialties in the electric lighting field. Mr. Gleason was never married, and is survived by two sisters and a brother.

PERSONAL.

MR. CAMPBELL-SCOTT, of the C & C Electric Company, returned last week from a brief European trip.

MESSRS. C. E. FREDERICK AND C. R. STURDEVANT have become associated with the engineering firm of E. P. Roberts & Company, Cleveland, Ohio.

MR. I. E. BURDICK has sold out his entire interest in the Naval Electric Company to Mr. F. G. Hall, Jr., his former partner, and has severed his connection with the company. Mr. Burdick will continue in the electrical field, but his arrangements for the future not being completed, his plans have not been made public.

MR. O. L. REMINGTON, the Australian representative of the Diamond Meter Company, of Peoria, Ill., is making a tour throughout Europe and America looking up electrical possibilities and developments in their relation to the trade of the new Commonwealth, with whose industrial condition he is thoroughly familiar. He will be at the Astor House in New York City about Oct. 21.

MR. JOHN D. ROCKEFELLER, it is said, has a private wire between his mansion at Forest Hill, Cleveland, and the Standard Oil offices in New York, and, with the aid of an operator, transacts all his business, involving millions, as though he were in New York. He uses the long-distance telephone occasionally, but never for important business. The mails he never uses. Mr. Rockefeller will remain at Forest Hill until October. Meanwhile, he devotes certain hours daily to work and has his secretary and telegraph operator constantly at his side. He never writes his messages, but simply talks to the operator as though he were engaged in conversation with another oil magnate in his New York office. When a question is asked the reply comes back instantly.

Trade Notes.

THE BURT MANUFACTURING COMPANY, Akron, Ohio, has just entered its tenth order for Cross oil filters for the Pittsburg Plate Glass Company.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has a neat catalogue devoted exclusively to telephone and annunciator systems. It is complete with data on that subject. If interested our readers should send for one.

A USEFUL SOUVENIR in the form of a pocketbook has been distributed by the Peerless Rubber Manufacturing Company, of New York. The use of the pocketbook by the recipient will serve as a frequent reminder of the excellence of the company's products.

THE HUGHES TELEPHONE COMPANY, Baltimore, Md., incorporated recently, will manufacture and install telephones, making a specialty of telephones for interior use, in hotels, apartment houses, etc. Its office is at 219 East Baltimore Street. T. Quincy Scott is secretary.

THE CENTRAL ELECTRIC COMPANY, of Chicago, claims for the Columbia lamp, high efficiency, long life, uniform candle-power, and even distribution of light. It solicits trial orders from those who have not tried the lamp, and assures all customers prompt shipment.

MR. WM. ROCHE, 42 Vesey Street, New York, manufacturer of the "New Standard" dry battery, whose factory was nearly destroyed by fire on Aug. 18 last, reports that he is now ready to fill all orders promptly, he having rebuilt and rearranged his factory, and his facilities are now better than ever before.

TOOL OUTFITS.—Complete tool sets for house or shop use are made up and placed in cabinets by Messrs. Hammacher, Schlemmer & Company, 209 Bowery, New York. A recent pamphlet shows illustrations of tool cabinets of various sizes, giving a list of the tools comprising each set. The class of tools considered is carpenter's sets.

POLE BRACKETS.—The Ohio Brass Company, Mansfield, Ohio, has recently issued a very complete and varied assortment of pole brackets comprising upwards of fifty different styles, each of which is supplied in all the standard sizes commonly in use. These brackets are made of either standard weight of wrought iron pipe or structural steel tubing, as may be preferred.

THE EUREKA ELECTRIC COMPANY, Chicago, is now making an extension to its factory. Its present quarters at 143-145 South Clinton Street are inadequate to the large amount of business, and it is now adding to its building the structure numbered 147-149 South Clinton Street. This will give it double the present capacity, enabling it to catch up with its orders, and to fill several large multiple board contracts, which boards are now in the course of construction.

THE IRON CITY ENGINEERING COMPANY is putting out a 24-inch celluloid rule on which its name and address appear with its telephone numbers and a memorandum of the general work in which it is engaged. In addition to the linear measurement on the face of the rule, there is contained a metric scale, while on the reverse side are wiring formulæ, wire gauges, belting formulæ, etc. The rule folds in four sections so as to make it very convenient for carrying in the pocket.

ELECTRO-THERAPEUTIC APPARATUS.—A full line of electrical apparatus for physicians, surgeons and dentists is manufactured by the Keystone Electric Company, Philadelphia, Pa. In a pamphlet of recent issue are described and illustrated instruments for the special needs of these professions. The Keystone Company calls attention to its complete and modern factory equipment, which enables it, with the aid of skilled mechanics, to manufacture electro-therapeutic instruments of the highest grade and best workmanship.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., has upon the press a very complete catalogue of its motors, generators and generating sets. Previous publications have been in the form of bulletins descriptive of special types. This catalogue will present them all, and will in some degree reveal the fact that although the Sturtevant Company has a world-wide reputation as a blower manufacturer, its business is by no means limited to the production of these useful machines, but that it is also equipped with a most complete line of engine and motor designs in small and medium sizes. In this respect, it is unique in this country.

LARGE CRANE.—The Brown Hoisting Machine Company, Cleveland, Ohio, is building for the Brooklyn Navy Yard a novel piece of machinery known as an electric pontoon crane. It consists of a traveling crane, capable of lifting a 100-ton weight, built on a large pontoon. The pontoon is 100 feet in length and the crane has an overhang at each end of 45 feet, so that the length of travel is 190 feet. At 95 feet from the center the crane can lift a 100-ton gun. The frame is so counterbalanced with automatically operating counter weights that the pontoon lists only 3 inches in lifting the weight mentioned. The crane will be utilized at the Navy Yard in transferring heavy weights to war vessels. It is to be operated by electric motors, and it is expected that it will be placed in operation some time this fall.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, states that its Fall business has opened up in a most satisfactory manner. This is especially true of its apparatus department, which has never before been so busy. It is exclusive agents for the Warren alternator, for alternating current apparatus, and the Eddy Electric Manufacturing Company, for direct current apparatus. It handles in connection with this apparatus, Moloney transformers, and Adams-Bagnall enclosed arc lamps. In connection with its apparatus department, it has a fully equipped engineering department, which is prepared to draw up plans and specifications for lighting plants, and, in fact, give any information and data necessary for the proposed installation of electric light and power plants. It also has a complete line of bulletins and descriptive matter, illustrating this apparatus, which will be sent upon application.

"SUCCESS."—The October number of *Success* is an industrial issue of considerable importance. Unlike the industrial issues of other magazines, however, the editors have wisely eschewed a dry record of statistics, and have woven the progress and romance of the United States in a selection of subjects that are valuable to all readers. The opening article is by Park Benjamin, who deals with "Great Problems of Invention." Dr. Benjamin graphically tells of the vicissitudes of the most successful inventors. He traces the beginning of the automobile, and, in this connection, his article is illustrated with an elaborate drawing of Edison in his laboratory, perfecting his storage battery. Charles R. Flint, one of the most prominent brokers and merchants in America, contributes a powerful paper on "How to Win, and Keep, the World's Trade." The growing trade of the Great Lakes is presented in a stirring, forcible manner by Mayor Harrison, of Chicago; Mayor Johnson, of Cleveland; Mayor Hugo, of Detroit; and Mayor Jones, of Toledo, who advocate and show the possibility and necessity of a deep waterway to the Atlantic Ocean. Robert Bruce Watson, the supervising architect of Illinois, tells, in "The Elevator Did It," how the American "skyscraper" was made possible.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED SEPT. 24, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

683,026. TROLLEY CATCHER; C. I. Earll, New York, N. Y. App. filed Feb. 26, 1901. The rope passes around a drum which is acted upon by two springs, one a light one to keep the rope taut, and the other a heavy one which is thrown into action when the wheel leaves the wire, to wind the drum.

683,045. ELECTRIC COUPLING FOR CONDUCTORS; C. Holzmann, Budapest, Austria-Hungary. App. filed March 5, 1901. A rail bond consisting of a rod fixed at one end to one rail and clamped to the other rail, the rod being split lengthwise for flexibility.

683,049. INCANDESCENT LAMP PROTECTOR; J. M. Howley, Bayonne, N. J. App. filed June 20, 1901. The lamp projects through a ring, across which is stretched a flexible diaphragm having a hole in the middle.

683,051. PAPER CARRIAGE FEED DEVICE FOR PRINTING TELEGRAPH MECHANISM; O. L. Kleber, Pittsburg, Pa. App. filed Sept. 10, 1900. Details.

683,052. ARMATURE CORE FOR ELECTRICAL MACHINES; G. Koppelmann, Schuttorf, Germany. App. filed June 15, 1901. The armature is built up of bunches of metal plates, insulated from each other and separated by spaces so that air can pass axially through the armature, for ventilating purposes.

683,062. INCLOSING STRUCTURE FOR ELECTRIC ARC LAMPS; W. H. Northall, Elwood, Ind. App. filed Nov. 12, 1901. The lamp casing is in two parts hinged together.

683,066. ELECTRIC TUBE WELDING MACHINE; O. Parapart, Cleveland, O. App. filed Sept. 1, 1900. A special arrangement of the die with respect to the conducting devices.

683,085. MANUFACTURE OF FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS; William Lawrence Voelker, of London, Eng. App. filed July 30, 1900. A cotton thread or cellulose filament is soaked in a solution of the salt or salts of the metal or metals intended to form the metallic base of a carbide, then dried, spooled and packed with powdered carbon and the carbide, and subjected to a temperature which will convert the salt into oxide. The filament is then carbonized by passing it through an electric arc while surrounded by a cylinder composed of the aforesaid base and enclosed within a vessel with hydrogen or other gas incapable of supporting combustion.

683,086. MANUFACTURE OF FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS; William Lawrence Voelker, of London, Eng. App. filed July 30, 1900. Apparatus for carrying out the process of the above patent.

683,089. PROCESS OF REDUCING OXIDS; Knut C. Wideen, Brooklyn, N. Y. App. filed Jan. 19, 1901. It is stated that at a temperature of 10,000° F. obtained by means of a solar heater or by the focussed heat from a number of electric arcs, alumina, silica, and other refractory oxids are dissociated and the metal may be recovered in pure state without the use of a reducing agent.

683,098. ELECTRIC CLOTH OR FABRIC; L. Baecker, Detroit, Mich. App. filed June 24, 1901. Zinc and copper wires are woven into a fabric for therapeutic uses.

683,107. SMELTING FURNACE; Leonard S. Dumoulin, of Flushing, N. Y. App. filed Oct. 13, 1899. (See Current News and Notes.)

683,130. TOY GRAPHOPHONE; T. H. Macdonald, Bridgeport, Conn. App. filed Feb. 21, 1899. A heavy wheel carrying the record disk is adapted to be set in motion and run a considerable time by inertia.

683,133. INTERCHANGEABLE ELECTRIC DISPLAY APPARATUS; G. L. Mason, New York, N. Y. App. filed Sept. 10, 1898. A switch device for lighting the proper lamps to produce various letters and figures successively upon a sign.

683,171. TRANSMITTER FOR EDUCATIONAL PURPOSES; C. S. Comins, Quincy, Mass. App. filed April 6, 1901. A perforated tape is used by the beginner to send signals to himself so that he may not know the signals that are transmitted, and thus learn entirely by sound.

683,172. ELECTRICAL BLOCK SIGNAL SYSTEM; S. L. Foster, San Francisco, Calif. App. filed Oct. 16, 1900. The signal on the end of a rotary shaft is rotated by two solenoids, the reciprocating movement of a common core being transformed into a rotary movement, by means of a pin and spiral slot.

683,186. THERMOSTATIC SWITCH; W. F. Singer, New York, N. Y. App. filed Jan. 14, 1901. Details.

683,213. ELECTRIC SWITCH; K. W. Mansfield and W. R. Thompson, South Norwalk, Conn. App. filed July 6, 1900. The switch is temporarily closed by a hammer blow against a ball, the displacement of the ball allows the circuit to be closed and the ball, in returning to its normal position, again opens the circuit.

683,214. SIGNAL SYSTEM; K. W. Mansfield and W. R. Thompson, South Norwalk, Conn. App. filed July 21, 1900. An interlocking arrangement for signals at the beginning and ending of a block.

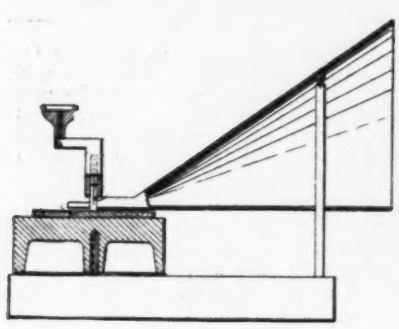
683,216. THERAPEUTIC BATTERY; J. A. Minturn, Indianapolis, Ind. App. filed June 10, 1901. The battery consists of two cells secured together end to end, with plugging arrangements for connecting one or both cells into circuit.

683,230. ELECTRIC CIRCUIT CLOSER FOR RAILWAY TRACKS; F. Sock, Magdeburg, Germany. App. filed Feb. 25, 1901. The shoe, against which a projection from the car strikes, is mounted to yield in a fore and aft direction while at the same time being pressed downward to close the circuit.

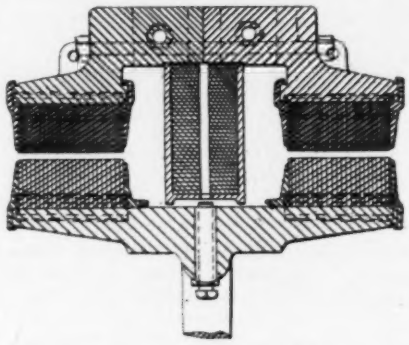
683,250. ELECTRIC RAIL BOND; S. P. Cowardin, Richmond, Va. App. filed Feb. 19, 1901. The end of the bond is a ring adapted to be clamped in an opening in the rail by means of an eyelet.

683,253. ELECTRIC GENERATOR OR MOTOR; P. J. Darlington, Montreal, Can. App. filed Aug. 15, 1898. The stationary armature ring is made in two parts joined together on a plane at right angles to the shaft and may be easily separated for inspecting the coils and hole.

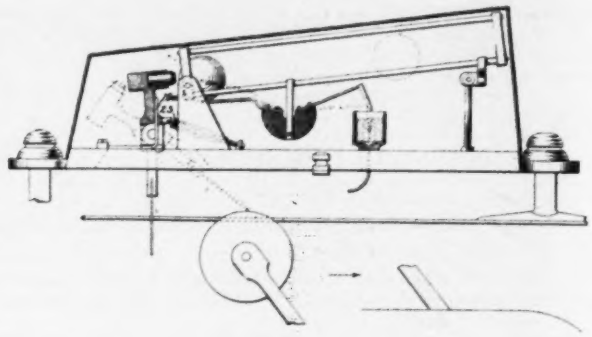
683,263. ELECTROLYTIC PRODUCTION OF CATHODE PLATES; Elmer G. Elliott and Valentine Kishner, of Perth Amboy, N. J. App. filed Dec. 29, 1900. (See Current News and Notes.)



683,130.—Toy Graphophone.



683,253.—Electric Generator or Motor.



683,213.—Electric Switch.

683,266. TELEPHONE RECEIVER; S. J. Friedman, McKeesport, Pa. App. filed Feb. 23, 1901. A clamp for the receiver.

683,279. CONTROL SYSTEM FOR ELECTRIC CARS; C. Hochenegg, Vienna, Austria-Hungary. App. filed Jan. 22, 1900. Devices whereby the control on each car is moved by gearing driven from the car axle, such gearing being controlled throughout the train from a single car.

683,283. ELECTROMAGNETIC TRACTION INCREASING APPARATUS; A. A. Honey, Tacoma, Wash. App. filed Nov. 20, 1900. The axles and wheels are magnetized to increase the attraction.

683,284. ELECTROMAGNETIC BRAKE; A. A. Honey, Tacoma, Wash. App. filed Nov. 22, 1900. The axles and wheels are magnetized to attract the brake shoes which are hung on a magnetizable brake beam to complete the magnetic circuit.

683,319. BURGLAR ALARM; W. G. McClure, Beaver Falls, Pa. App. filed Nov. 14, 1900. Details.

683,332. ELECTROMAGNETIC BRAKE; A. A. Robertson, Titusville, Pa. App. filed April 18, 1901. A ring-shaped magnet surrounds the axle and creates a braking force by inducing eddy currents in another ring carried by the axle.

683,341. ELECTRIC ALARM MAT; A. D. Shaw, New York, N. Y. App. filed June 25, 1901. Two metallic nets incorporated in a single mat and insulated from each other.

683,397. SIGNALING MECHANISM; R. Herman, Crafton, Pa. App. filed Jan. 14, 1901. In a signal mechanism, a signal having a bias to danger position, electrically operated mechanism for electrically locking the signal at caution and clear positions, and a circuit controller operated by the driving means for controlling the lock-circuit during the movement of the signal from danger to clear position, means normally acting to operate the circuit-controller during the movement of the signal from clear to danger position.